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THESIS

**MULTIDIMENSIONAL SCALING
OF USER INFORMATION SATISFACTION**

by

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Multidimensional scaling shed a different light on information satisfaction data, making them easier to visualize and interpret. While the differences were not substantial between multidimensional scaling and factor analysis, we concluded that the possibility of remarkably new insights gained through multidimensional scaling were well worth the small marginal cost of undertaking the analysis.

Multidimensional scaling (MDS) provides an information technology (IT) manager with possible new perspectives in the analysis of user's satisfaction with information and with information systems. The technique probes for meanings locked in user satisfaction data that are not accessible by other analytic procedures. IT managers should be, in all cases, skeptical of contrived hypothesis testing and factor analyses that deal with satisfaction data only at its face value. MDS gives managers a tool by which they can identify meanings beyond the obvious. Coupled with the careful and effective use of the semantic differential question format, MDS is a powerful means to escape the fatal flaw in data gathered by survey questionnaires: socially desirable responses.

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Multidimensional Scaling of User Information Satisfaction

by

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ABSTRACT

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I. INTRODUCTION

User information systems have become a catalyst by which the Department of Defense (DoD) is able to deal with constantly shrinking budgets. It is reduction in funds which make effective use of information system of such importance.

The Composite Health Care System (CHCS) is only one of the billion dollar information systems used by DoD to cope with increased requirements for processing information.

Management of information systems is not something that can be done on an Ad Hoc basis. It is a demanding responsibility that requires strategic planning and close scrutiny. Whether an information system is effective depends upon end-user's perceptions. DoD must have a means by which to determine if dollars spent in development and deployment of major information systems such as CHCS are seen as effective in the eyes of the users of such systems.

A. RESEARCH OBJECTIVES

The primary objective of this research was to determine if multidimensional scaling tells us more about user perceptiion of satisfaction with information systems than does

conventional factor analysis. Management is eager to find a tool that assesses user satisfaction with their information systems.

II. LITERATURE REVIEW

A. INTRODUCTION

During this research, I reviewed 66 articles in professional journals and trade periodicals on user satisfaction of information systems. Academics have done research in the area and to date there is no single definition of user satisfaction. In this study, the analysis will employ multidimensional scaling comparing the results with those of a previous study using factor analysis. I reviewed literature in three areas: user satisfaction, multidimensional scaling and factor analysis.

B. USER SATISFACTION/EFFECTIVENESS

The DoD budget for automated information systems (AIS) in fiscal year 1990 was in excess of $9 billion. A majority of these funds were used to modernize or simply maintain existing systems. At this amount, DoD cannot afford to have AIS which are ineffective and unused. It is for this reason user satisfaction is of great importance.

The literature classifies user satisfaction into various categories to include: 1) value of information systems economically, 2) information systems effectiveness, and 3) information systems usage. Consequently, studies tend to indicate if a user of an information system is not satisfied

with the system, he/she will not use that system regardless of the cost or the perceived effectiveness.

1. Economic Value of Information Systems

The economic value of information systems refers in general to two aspects of measuring user satisfaction: 1) value analysis and 2) cost benefit analysis (CBA). The value analysis technique is geared more towards the effectiveness of decision making systems. It is used by managers to determine whether the user is willing to pay more to keep the present decision support or add to the DSS to gain additional benefits (Cyrus, 1991).

A more commonly used measure is CBA. This measurement is applied to AIS when there is an investment issue to be explored. Because acquisition of AIS can be a complex procedure and the cost can often exceed a billion dollars, CBA is used extensively. The essential aspect to remember is that "cost benefit analysis relies on the fact that costs and benefits can be estimated with reasonable accuracy" (Cyrus, 1991).

2. Information Systems Effectiveness Measures

Various instruments have been developed to measure the effectiveness of user information systems (UIS) (Bailey and Pearson, 1983; Mick, et al., 1980; Montezami, 1988; Schultz and Slevin, 1975; King and Epstein, 1982; Chandler, 1982; Ives, et al., 1983; and Baroudi and Orlikowski, 1988). While

this list is not all inclusive, it does represent a sample of the research that has been done in the field.

Bailey and Pearson (1983) developed a semantic differential instrument which they claim, has been validated. It has been used in studies to determine how users feel about their information systems. Their instrument was a 39 item questionnaire with four adjective pairs for each item. This instrument was later refined by Baroudi and Orlikowski (1988) into a short-form consisting of 13 items with two adjective pairs per item.

The Baroudi and Orlikowski (1988) short form is of significance because it is the form that was used by Hurd (1991) to evaluate the CHCS (Hurd, 1991). Lockhart (1992) expanded Hurd's work with two additional naval hospitals that were evaluating the CHCS. The results from these evaluations will be discussed later.

3. System Usage of Information Systems

System usage has been discussed in research as a behavioral surrogate by users. This is part of the reason semantic differential scales are used in questionnaires which seek to measure UIS effectiveness. The semantic differential attempts to capture the attitude of users (Osgood, et al., 1957). When a user is forced to use an information system then the amount of usage cannot be a factor in measuring system effectiveness. It is only when system usage is

voluntary that it is a measure of information system satisfaction. Bailey and Pearson (1983) suggest a direct linkage between user satisfaction and system usage. However, Baroudi et al. (1986) indicates there is more of an indirect relationship. They suggest user involvement in the development or modification of information systems has a causal relationship upon user satisfaction and system usage. "User information satisfaction is an attitude toward the information system while system usage is a behavior" (Baroudi et al., 1986).

C. MULTIDIMENSIONAL SCALING

Multidimensional Scaling (MDS) is used to develop a geometric picture of the locations of objects relative to one another in meaning space. This picture shows how objects differ or are similar. It also reveals any hidden meanings of data and sometimes makes them easier to understand (Kruskal and Wish, 1978). Measuring constructs such as user satisfaction is an example of something difficult to understand. If users' perception of a system are similar, then items will fall close together in multidimensional space. Items which are perceived to be dissimilar will be farther apart (Emory and Cooper, 1991).

When using MDS the data can of two types: metric or nonmetric. Metric data mean there are equal intervals between data points (e.g., -39 to +39, -3 to +3). For example, the

distance between data values of 3 and 5 is the same as between 7 and 9. Kruskal and Wish (1978) describe metric MDS as "a relationship described by an ordinary formula using numerical or metric properties of the proximities".

Kruskal and Wish (1978) describe nonmetric MDS as "an MDS in which an increasing function, or alternatively a decreasing function is aimed for. It only depends on the rank order of the proximities". As nonmetric data refer to nominal or ordinal data (e.g. very high, high, neutral), Kruskal and Wish's description agrees with those of Emory and Cooper (1991) and Green and Rao (1972).

Determining the number of dimensions to use with MDS is the first step in MDS analysis. The greater the number of dimensions the greater the accuracy of interpretation. Dimensionality refers to the number of coordinate axes upon which graphical representation will take place. This is akin to the number of factors in factor analysis.

In addition to the dimensionality consideration, other decisions have to be made when using multidimensional scaling. These considerations include: interpretability, ease of use, and stability. It is because of these other considerations that MDS is nearly always used as a descriptive model for representing data under analysis (Kruskal and Wish, 1978).

The intent of MDS is to describe the perception of the respondents about an object which in this case is an

information system. The perception is displayed in a spatial form which can be of three types called attribute space.

- Objective Space: an object can be positioned in terms of its flavor, weight, nutritional value, speed of processing
- Subjective Space: where a person's perception of flavor, weight, nutritional value, or speed of processing may be positioned
- Ideal Attributes: all objects close to the ideal are interpreted as being preferred by us over those farther away (Emory & Cooper, 1991)

While objective space and subjective space may not coincide, they may provide information on perceptual disparity. Additionally, subjective space may vary over time which can provide insight on trend data.

Multidimensional scaling has various conceptual approaches to scaling of similarities data. They are described by Green and Rao (1972):

- Respondent Task: overall similarities/dissimilarities responses to unspecified criteria versus ratings on specified constructs followed by computation of some derived measure of similarity.
- Experimental Emphasis: scaling of aggregate or grouped data versus methods that retain individual differences.
- Scaling Method: metric versus nonmetric scaling algorithms.

In a matrix form, descriptors take on combinations allowing for possibilities of interpreting data once it is processed through a MDS program.

D. FACTOR ANALYSIS

Factor analysis looks for patterns among variables to discover if an underlying combination of the original variables (factors) can summarize the original set (Emory and Cooper, 1991). Long (1983) defines factor analysis as "a statistical procedure for uncovering a (usually) smaller number of latent variables by studying the covariation among a set of observed variables." As with MDS, factor analysis can be use for either metric or nonmetric data. Factor analysis is used mostly for exploratory studies because of the interpretational nature in which factor loading is used. This interpretational nature of factor analysis causes it to be subjective (Emory and Cooper, 1991). For this reason, there is no definitive way to calculate the meanings of factors. It is thus a "what you see, is what you get" type of technique.

Factor analysis is not without its problems. When attempting to interpret the results of factor analysis certain things can affect the process. For example, if the sample is too small, replicating might cause different results. Another problem might be if more factors are extracted, the results can be different from the original patterns. There is thus the need for more careful interpretation when using factor analysis.

III. RESEARCH METHODOLOGY

A. INTRODUCTION

This study compares the analyses of two studies of user information satisfaction (UIS) using factor analysis and multidimensional scaling. The first study by Hurd (1991) was to identify characteristics of UIS for users of the Composite Health Care System (CHCS) at the Naval Hospital, Charleston. The second study by Lockhart (1992) expanded Hurd's work with data on two additional Naval hospitals. Lockhart also evaluated the validity of the survey questionnaire form being used. He suggested that factor analysis was an appropriate method for determining construct validity.

This study will analyze the raw data from the Hurd and Lockhart studies with multidimensional scaling to determine if it will reveal meanings not found using factor analysis.

B. SAMPLE AND DATA COLLECTION

1. Background of the Composite Health Care System (CHCS)

CHCS is an integrated medical information system the DoD is testing for implementation in medical facilities. CHCS is designed to improve the timeliness, availability, and quality of patient-care data. It will replace manual and older automated information systems now supporting DoD medical treatment. At individual hospitals, it will integrate the

functional work centers of inpatient and outpatient facilities, patient administration, patient appointment and scheduling, nursing, laboratory, pharmacy, radiology and clinical dietetics. CHCS is intended to provide physicians with immediate access to patient medical records (GAO-IMTEC-90-42, 1990).

2. Sample and Collection of Data

The three naval hospital operations test and evaluation (OT&E) sites (Charleston, South Carolina; Jacksonville, Florida; and Camp Lejeune, North Carolina) were examined in this study. Hurd's (1991) data from the Naval Hospital Charleston, and Lockhart's (1992) data from the Naval Hospitals at Jacksonville and Camp Lejeune, were used in this study in lieu of re-sampling. The three sites are approximately medium-sized naval hospitals ranging from 170 to 184 beds. Outpatient clinic visits range from 360,000 to about 570,000 per year (GAO/IMTEC-90-42, 1990). No complete inpatient module implementation had occurred at any of these hospitals at the time of this study. Therefore, the nursing module was not evaluated. Additionally, the clinical dietetics model was not implemented. The modules that were implemented were: patient administration (PAD), patient appointment and scheduling (PAS), pharmacy (PHR), laboratory (LAB), and radiology (RAD). The PAD module was still being run in parallel with the AQCESS system, and did not have the

cash collections component (MSA) on-line. The LAB module did not have the blood transfusion service component on line.

Both Hurd (1991) and Lockhart (1992) used a short-form UIS instrument for data collection. Hurd used the short-form questionnaire developed by Baroudi and Orlokowski (1988). Lockhart modified the questionnaire, specifically questions 8 and 10. He made these changes to clarify the questions by using Bailey and Pearson's definitions offered by Bailey and Pearson (1983) (see Appendix A). He felt that there could be misunderstandings interpretation by the subjects.

The data collection set employed by Hurd and Lockhart consisted of a cover letter, the short-form UIS instrument, and an addressed return envelope. The cover letter informed respondents that their responses would be held in confidentiality.

A point of contact at Naval Hospital Charleston distributed 180 questionnaires. The CHCS Project officer was sent 250 data collection sets for the Naval Hospital Camp Lejeune and Naval Hospital Jacksonville. General guidance for dissemination at each facility was provided to ensure random sampling of all CHCS users in the outpatient areas (i.e., physicians, clinics, laboratory, radiology, pharmacy, and administrative departments). Upon return of the responses from the hospitals, data were coded and categorized into three functional groups: physicians, medical support, and administrative support. Lockhart grouped the respondents

differently from the Hurd (1991) study, stating his "groupings better represent the different user groups in terms of the function provided to health care, and therefore use of the CHCS" (Lockhart, 1992).

Education, sex, use of other computer systems, and use of other health care information system demographic information were recorded with dichotomous values (i.e., male=1, female=2, no=0, yes=1, high school graduate=0, etc.).

All responses were inputted using the Enable OA an integrated software package. This package allows the researcher to build a database of responses and ease of data retrieval and importation of this data into a spreadsheet format for statistical analysis. Each of the questions (variables), factors, and overall satisfaction scores were computed as described by Baroudi and Orlikowski (1988).

C. MEASUREMENT SCALES

In psychological studies, there is confusion as to the legitimacy of using particular classes of mathematical procedures (Galletta and Lederer, 1989; Nunnally, 1978). Specifically, the use of parametric statistical procedure verses nonparametric procedure with measures of psychological attributes. Parametric statistical procedures have more statistical power than nonparametric procedures, However they require, at a minimum, the use of interval data. According to Nunnally, an interval scale

> 1) the rank-ordering of objects is known with respect to an attribute and 2) it is known how far apart the objects are from another with respect to the attribute, but 3) no information is available about the absolute magnitude of the attribute for any object (Nunnally, 1978).

Scaling models such as the seven interval Likert-type scaling model used with the short-form UIS instrument, are applied by the researcher to what appears to be ordered categories (or ordinal scales) to the subjects, to convert the data into interval scales. Nunnally (1978) strongly believes that it is permissible to take seriously the intervals among scores in performing analyses of attitude such as that used with the short-form UIS instrument. It is beyond the scope of this paper to fully explain the rationale behind these arguments, and it is recommended that readers review Nunnally (1978).

In this study, *parametric procedures* will be used, however, nonparametric procedures will be used in those cases where testing failed to support the underlying assumptions for parametric procedures (specially, in the oneway ANOVA procedure). All testing was conducted at a confidence level of 95% or alpha = 0.05.

D. VALIDATION OF THE INSTRUMENT

1. Homogeneity of the Sample Data Sets

Oneway analysis-of-variance (ANOVA) using a PC version of MINITAB statistical program and macro programs (Schaefer and Anderson, 1989) provided by Zehna (1990) were performed on the following demographic attributes: education, age, gender,

length of time (in months) of CHCS use, use of other computer systems, and use of other health care information systems to ascertain homogeneity of the sample data sets. ANOVA methods have been developed to test for differences between the means of several groups. In this study, ANOVA procedures were applied to the three subpopulations: Charleston, Camp Lejeune, and Jacksonville. Where significant differences in means occurred, the Scheffe multiple comparison testing was conducted *a posteriori*. Additionally, *a posteriori* testing for normality and homogeneity of variance was conducted.

Normality was tested using MINITAB's option for computing and storing fitted and residual values. Applying the NSCORE function to compute the normal scores of the residuals and then compute the correlation of the normal score with residuals approximates a normal distribution if the correlation is large (i.e., the closer to 1.0 the better) (Schaefer and Anderson, 1989). The Hartley's Fmax test was used for homogeneity of variance.

2. Common Factor Analysis

The common factor-analytic model is different from principal components analysis in that it makes a distinction between common and specific parts of variables. In principal components analysis, the goal is to construct linear combinations of the original variables that account for a large part of the total variation. That is to say, the

unobserved factors (latent variables) are expressed as functions of the observable variables, and is variance oriented, and without an error term. The common factor-analytic model, on the other hand, expresses each observable variable in terms of unobservable common factor and a unique factor, and is covariance oriented.

The common variance of a variable is called the communality of the variable. The communality of a variable is the portion of the variable's total variance that is accounted for by the common factors. With the principal components analysis there is no error term. Conceptually, the absence of an error term implies that the observable variables are measured without error and that the unobservable latent principal component is a perfect linear combination of its measures or are formative indicators of the unobservable factor.

Whereas, common factor analysis is reflective in that the indicators subjective to measurement error are a function of unobservables. Instrument construct to assess attitude are typically viewed as underlying factors that give rise to something that is observed, and therefore their indicators (i.e., the observed variables) should be viewed as reflective, hence the use of the common factor-analytic model. Common factor-analytic techniques can better serve the functions of searching the data for qualitative and quantitative

distinctions and, especially testing *a priori* hypotheses and statistical testing criteria (Dillon and Goldstein, 1984).

The maximum-likelihood common factor analysis is preferred due to its ability to test hypotheses about the number of common factors. There are two different data analysis contexts: exploratory and confirmatory. Exploratory factor analysis is simply searching for a common structure underlying the data without having any theoretical hypothesis in mind. Whereas, confirmatory factor analysis there exists some prior theoretical information on the common structure underlying the data and one wishes to confirm or negate the hypothesized structure (Dillon and Goldstein, 1984; SAS, 1989).

The rotation process of factor analysis pattern matrix provides a clearer delineation of the pattern of relationships. Rotation options allow for a simple factor solution to become clearer. There are two methods in which the factor axes can be rotated. Orthogonal rotation preserves the original orientation between the factors so that they are still perpendicular after rotation. Whereas, oblique rotation, the factor axes can be rotated independently. Varimax orthogonal rotation spreads variance evenly among factors while maintaining the original orientation between the factors so that they are still perpendicular after rotation. The procedure seeks to rotate factors so that the variation of

the squared factor loadings for a given factor is made large (Dillon and Goldstein, 1984; SAS, 1989; Stewart, 1981).

a. Exploratory Factor Analysis

Initially, exploratory factor analysis was undertaken using SAS maximum-likelihood factor analysis procedure (SAS, 1989) on the combined data. Multivariate normality was assumed in conducting the exploratory factor analysis. Cattel's scree test was performed for determining the approximate number of factors to extract. The Cattell's scree test is simply a visual determination of the point where the factors curve above an approximate straight line made from the bottom roots (Stewart, 1991).

SAS (1989) has the capability of computing the Kaiser-Meyer-Olkin (MSA option) measure of sampling adequacy. The MSA is a summary of the extent to which the variables belong together and are thus appropriate for factor analysis (Stewart, 1981). When MSAs are greater than 0.8, they can be considered good (SAS, 1989; Stewart, 1981). Schwartz's Bayesian Criterion is used to determine the best number of factors to be extracted using the maximum-likelihood factor analysis procedure. The number of factors that yields the smallest value for the Schwartz's Bayesian Criterion is considered the best extraction (SAS, 1989). Schwartz's Bayesian Criterion according to the SAS user guide seems to be less inclined to include trivial factors than eitner the

Akaike's Information Criterion or the chi-square test (SAS, 1989).

In the literature there have been problems reported in using the chi-square test due to its susceptibility to sample size (Mulaik, et al., 1989; Bentler and Bonnett, 1980; Byrne, et al., 1989; Marsh and Hocevar, 1985). SAS also provides the Tucker and Lewis' Reliability Coefficient automatically for maximum-likelihood factor analysis procedure. The closer the Tucker and Lewis' Reliability Coefficient is to 1.0 the better the factor solution fit. SAS also automatically computes the squared canonical correlation (which is the same as squared multiple correlations) for maximum-likelihood factor analysis procedure. The square multiple correlation (SMC) for each variable is the relative variance in that variable which is accounted for by the overall solution jointly (SAS, 1989; Jöreskog and Sörbom, 1988).

Basically, the SMC represents the lower bound of reliability that each variable contributes to the overall factor structure. The maximum-likelihood factor analysis procedure because it is an iterative process using SMCs for initial estimates (using SAS) is susceptible to quasi- or ultra-Heywood cases. It is beyond the scope here to discuss these anomalies, however, SAS has a Heywood option which sets to 1 any communality greater than 1, allowing iterations to proceed until convergence criterion is met (1989). The

Varimax rotation option was used in the SAS procedure program. Lastly, the data was standardized using the SAS procedure STANDARD and retested using the maximum-likelihood procedure as above.

b. Confirmatory Factor Analysis

After obtaining the optimal factor structure solution via exploratory factor analysis, confirmatory factor analysis was conducted. This time multivariate normality was not assumed and the observed variables were analyzed for goodness of fit to the optimal exploratory factor analysis model using Jõreskog and Sõrbom's LISREL 7 (Linear Structural Relations) computer program. The LISREL model can be viewed in terms of a confirmatory factor analytic model (Dillon and Goldstein, 1984). Jõreskog and Sõrbom (1988) in their LISREL 7 manual provide testing cases for non-normality where the observed variables are on interval scales using Weighted Least Squares analysis. Using Jõreskog and Sõrbom's (1981-1989) PRELIS program, the raw data is converted and saved as a polychoric correlation matrix and an asymptotic convariance matrix to be used in the confirmatory factory analysis (Jõreskog and Sõrbom, 1988; 1981-1988). In addition to the Total Coefficient of Determination (TCD), Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), and Root Mean Square Residual (RMR), the output will provide the Standard Errors (SE), and t-values (TV).

LISREL's t-values or critical ratios when larger than two are normally judged to be significantly different from zero, and therefore indicating a true parameter for loading in that factor (Jöreskog & Sörbom, 1988). The TCD is a measure of how well the variables jointly serve as measurement instruments for the overall factor structure. The closer to 1.0 the TCD, GFI, and AGFI are, the better the model fits the data. The RMR and SEs should all be very small to indicate overall good fit of the data. There is some debate about the use of the GFI. Mulaik et al. (1989), in a recent evaluation recommends the use of GFI when one has samples at least 200 in size, and of course when the condition for that method are satisfied.

3. Reliability (Internal Consistency) Testing

Internal consistency was tested for each factor using Cronbach's Alpha reliability coefficient option in SAS's correlation procedure (SAS, 1990). Cronbach's Alpha is based on the average correlation of items within a factor (or test). It represents the correlation between this factor (or test) and all other possible factors (or tests) containing the same number of items, which could be constructed from a hypothetical universe of items that measure the characteristic of interest (i.e., the factor). It also sets an upper limit to the reliability of the factor. If it proves to be very low, either the factor has too few items or the items have

very little in common (Nunnally, 1978). According to Nunnally (1978), reliability coefficients of .70 or higher will suffice in the early stages of research, and for basic research, efforts to increase much beyond .80 is often a waste of time and funds.

4. Testing for Measurement and Structure Invariance

Having conducted common factor analysis on the data as a whole, the next verification is to test that the factor structure and loading are the same for each of the three subpopulations. In addition, before conducting ANOVA testing of the three subpopulation location's for evaluating the difference in means, it is important to confirm that the measurement and the structure of the instrument designed to ensure attitudes are *equivalent across* the subpopulations (Byrne et al., 1989; Marsh and Hocevar, 1985; Drasgow and Kanfer, 1985).

Jöreskog and Sörbom (1988) provide a methodology to analyze data from samples simultaneously using their LISREL models. They outline a series of tests to be conducted to confirm measurement and structural invariance. The first test is an overall test of the equality of covariance matrices across the three subpopulations. Failure to reject the null hypothesis (i.e., covariance matrices are equal) is statistical evidence that the groups can be treated as one.

The next series of testing consisted of a model in which certain parameters are constrained to be equal across the subpopulations is compared with a less restrictive model where these same parameters are free to take on any value (Byrne, et al., 1989; Jŏreskog and Sŏrbom, 1988). In each of these tests, at least one of the scales or items making up each of the factors must be fixed to 1.0. The highest loading item (from previous factor analysis above) was fixed to 1.0. There is no guidance in the literature as to which item to fix, and to iteratively fix the various items in each factor is problematic. The choice uses that item which strongly loads into its respective factor, and therefore setting it to 1.0 seemed appropriate.

The second test examined whether there are four factors in all three subpopulations with a factor pattern of: Factor A consists of questions 1, 6, 11; Factor B consists of questions 2, 12; Factor C consists of questions 7, 8, 9, 10, 13; and Factor D consists of questions 3, 4 and 5.

The third test was for invariance in factor loadings (lambda x) across the subpopulations. The fourth test was for invariance in the error/uniqueness (theta) across the subpopulations. Lastly, a fith test examined whether the factor variance and covariance (phi) are invariant across the three subpopulations.

For the second test, subpopulations 2 and 3 are specified to have the same pattern and the same starting

values as subpopulation 1 (LX=PS command on the LISREL 7 model input line). For the third test, subpopulations 2 and 3 are specified to be invariant for factor loading from subpopulation 1 (LX=IN command on the LISREL 7 model input line). The fourth test additionally constrained the theta matrices to be invariant (TD=IN command on the LISREL 7 model input line). The fifth test additionally constrained the phi matrices to be invariant (PH=IN command on the LISREL 7 model input line). The LISREL 7 output provides the GFI and RMR for each subpopulation. The chi-square measure provided with the last subpopulation was the measure of the overall fit of the three subpopulations. Alternative indices used to help evaluate LISREL models in multiple sample analysis where the chi-square measure and degrees of freedom are reported as summed values from the multi-sample testing (as in this testing) are: the chi-square to the degrees of freedom ratio, and the chi-square likelihood ratio tests. The chi-square/degrees of freedom ratio is distributed as a t-statistic so that anything greater than 1.96 (in this instances, where n=340, and alpha = 0.05) is significant (Marsh and Hocevar, 1985). The chi-square likelihood ratio (LR), also described as the chi-square difference test, is used where restricted nested models are used as in this case where the third, fourth, and fifth tests are restricted nested models of the second test. The LR test is calculated by taking the difference in the chi-square estimators for the

restricted and unrestricted models and the difference in degrees of freedom (df) for the two models and reporting as a chi-squared/df ratio (Byrne, et al., 1989; Marsh and Hocevar, 1985; Bollen, 1989).

5. Post Survey Interviews (Convergent Validity)

Convergent validity is the extent that a measure is correlated or "agrees" with other measures of the same construct (Ives, et al., 1983). Interviews were conducted with randomly selected members of the user groups at the Naval Hospitals Camp Lejeune, and Jacksonville. The interviews were conducted to assess users overall satisfaction with the system for comparison with the questionnaire results. Additionally, the interviews were used to gain comments about the system, and the short-form UIS instrument used in this study. Subjects interviewed were assured that their responses would be kept confidential.

E. EVALUATION OF THE INSTRUMENT'S DATA

1. Testing Differences in Means

Oneway analysis-of-variance (ANOVA) testing was conducted as described above for testing homogeneity of sample data sets. First, Lockhart (1992) combined the three hospital data sets to test the difference in means between the three user groups (physicians, medical support, and administrative support) for each of the 13 questions, overall score, and factors. Using the combined data set, each user group was

tested for differences in means between the three location sites (i.e., Charleston vs Camp Lejeune vs Jacksonville). Lastly, each hospital's data were tested for differences in means between the three user groups.

Where significant differences in means occurred (i.e., P value less than 0.05), the Scheffe multiple comparison testing was conducted *a posteriori*. Additionally, *a posteriori* testing for normality and homogeneity of variance was conducted. Normality was tested using MINITAB's option for computing and storing fitted and residual values when performing oneway ANOVA procedure. Applying the NSCORE function to compute the normal scores of the residuals and then computing the correlation of the normal score with residuals approximates a normal distribution if the correlation is large (i.e., the closer to 1.0 the better) (Schaefer and Anderson, 1989). The Hartley's Fmax test was used for homogeneity of variance.

Nonparametric Kruskal-Wallis ANOVA testing of sample medians was conducted in those situations where parametric ANOVA testing assumptions were violated (i.e., lack of normality and/or homogeneity of variance). Using a PC version of MINITAB statistical program (Schaefer and Anderson, 1989), the Kruskal-Wallis test statistic H and P values were calculated and adjusted for ties in responses. Where significant differences in medians occurred, the MINITAB (Schaefer and Anderson, 1989) nonparametric Mann-Whitney two-

sample median procedure was performed in pairwise comparisons to identify individual significant differences.

2. Time of Use Correlation Testing

The assumption held is that as the length of time of use of the system increased, the user's level of satisfaction would increase. The CHCS is a mandatory use system as opposed to as optional use system. As such, medical personnel must use the CHCS to accomplish their work (in those areas where respective CHCS modules have been installed).

Correlation measures the degree of association between two variables. The range of correlation strength can be from -1.0 (perfect negative correlation) to +1.0 (perfect positive correlation), with zero meaning no correlation. The term "negative" used here with correlation denotes that as one variable increases the other variable decreases. The term "positive" used with correlation denotes that as one variable increases the other variable increases. The independent variable used in this study was time of use of the CHCS (in terms of months). The dependent variable to test against were each factor's mean scores. The Pearson's sample correlation coefficient (r) was obtained by Lockhart (1992) for each comparison using MINITAB. It should be noted that rho and its estimate r are both symmetric so that the two variables to be correlated can be interchanged without changing the value. It is because of this symmetry that no cause and effect statement

may be made, rather just the strength of association or relationship between the two variables (Zehna, 1990).

The Pearson's sample correlation coefficient was tested for significance using a macro program provided by Zehna (1990) for MINITAB. The testing of the sample correlation coefficient (r) used one-tailed hypothesis testing where H1: rho > 0 if r was positive or H1: rho < 0 if r was negative to obtain the appropriate P value. A P value of less than 0.05 indicates that the null hypothesis of no correlation may be rejected. Correlations were performed on the combined three hospital data.

a. Trend Analysis

Hurd (1991) found that none of the work groups demonstrated any *high correlation* between time of use and the level of satisfaction. However, he used six month time series intervals to look for possible trends (negative or positive) between the time of use of the CHCS and the overall UIS summed score. He found at the Naval Hospital Charleston, that physicians and administrative support tended to exhibit a positive trend-line, whereas, the ancillary group (which is part of the Medical Support group in this study) tended to exhibit a negative trend-line for overall satisfaction.

In this study, the trend analysis performed by Hurd (1991) was replicated. Trend analysis of the mean score in six month intervals for each factor was conducted. The number

of individuals involved in each six month interval and the percentage of the whole were tabulated to provide clarity as to the weighing of the results. The trend analysis was performed on the combined three hospital data.

F. MULTIDIMENSIONAL SCALING METHODS

Multidimensional scaling (MDS) is an attempt to further probe respondents' perceptions in the data collected from the three naval hospitals. According to Schifmann et al. (1981), MDS is a mathematical tool which shows the similarities of variables in a spatial map. Perception of satisfaction data collected by Hurd (1991) and Lockhart (1992) was prepared to be input to SPSS-X (SPSS, 1988) for processing. The proximity matrices generated by the SPSS command PROXIMITIES were used as input to ALSCAL. The SPSS procedure ALSCAL was used to multidimensionally scale the Hurd-Lockhart data. The ALSCAL procedure was used to determine differences or similarities in the 13 satisfaction variables from the short form questionnaire. ALSCAL produced two-dimensional nonmetric Euclidean multidmensional scaling solutions with ordinal data (SPSS, 1988).

1. Determining Proximities

Proximities are data sets which depict the amount of perceived difference between each pair of a set of stimuli (Schifmann et al., 1981). SPSS procedure PROXIMITIES determines such proximities. A data list from the 13

satisfaction variables were are used as input. Table 3.1 shows the variable titles used. Additionally, we specified that the variables were to be processed as proximities between variables.

TABLE 3.1
PROXIMITY VARIABLE NAMES

PLOT SYMBOLS	MEANING	SEMDIFF
1 RELMID	Relationship of user to MID staff	harmony/diss good/bad
2 CHGSYS	Processing of requests for changes to system	fast/slow timely/untimely
3 TRNG	Training provided to users	compl/incompl high/low
4 UNDERSTD	User's understanding of the system	suff/insuff complete/incomplete
5 PARTIC	User's feeling of participation	pos/neg suff/insuff
6 MIDATT	Attitude of the MID staff	co-op/billegerent pos/neg
7 RELYINFO	Reliability of output	high/low superior/inferior
8 RELVINFO	Relevance of output	useful/useless relv/irrelv
9 ACCINFO	Accuracy of output	acc/inacc high/low
A PRECINFO	Precision of output	high/low definite/uncertain
B MIDCOMM	User's communication with MID staff	harmony/diss productive/unprod
C TIMEDEV	Time required for systems development	reasonable/unreas acc/unacc
D COMPLETE	Completeness of output	suff/insuff adequate/inadequate

This procedure yielded a matrix of distances used as input to ALSCAL. Matrices for each hospital and combined hospital data are shown in Appendix C.

2. Spatial Mapping

Proximities computed for each hospital and combined hospitals were stored in a file and used as input to ALSCAL for the purpose of developing a spatial map. A spatial map depicts the relative similarities or dissimilarities among the variables. If variables are closely related the coordinate points on the map will appear close together. If the variables are different, the points will appear further apart. This map is the objective of MDS. From it one can interpret the meaning behind the distribution of the points.

ALSCAL assumes that the input data are one or more square symmetric matrices with elements at the ordinal level of measurement. ALSCAL will produce solutions for n dimensions. However, the default is two dimensions. The default settings were used here. The output consisted of two-dimensional nonmetric Euclidean multidimensional scaling solution. Finally, the output will include the improvement in Young's S-STRESS for successive iterations, two measures of fit for each input matrix, the derived configuration and weights when appropriate (SPSS, 1988).

MDS has a lower chance of error in an experiment (Schiffmann et al., 1981). It does not require previous knowledge of the variables being used.

3. Dimensionality

Dimensionality refers to the number of coordinate axes used to locate a point in the spatial map. Although this concept seems simple, it can be ambiguous. The number of interpretable characteristics for a spatial map can often be less than the actual dimensionality. For example, we may only be able to interpret two dimensions even though the data may indicate a three or four dimensional configuration.

Determining the dimensionality is as much an art as it is a statistical procedure. While it is true that the higher the dimensionality, the more accurate the representation in the spatial map, it is also true that the ability to interpret the distribution of data points becomes more difficult with an increase in dimensions. Therefore, it is practicable to use two and seldom more than three dimensions.

Part of interpreting the dimensions is based on the goodness of fit of the data. This fit is depicted by a stress measure. Kruskal and Wish (1978) define stress as the "square root of a normalized residual sum of squares". The higher the stress value the worst the fit of the data. We were able to use the S-STRESS value which is given as an output for the ALSCAL procedure. Most MDS algorithms use the stress measure

as a criterion for determining the best fit between an original input matrix and the estimated distances in a low-dimensional solution (McCain, 1990). Kruskal and Wish (1978) warn that a numerical value may indicate good fit for one measure and bad fit for another. The ALSCAL procedure yields a stress value and squared correlations to help determine the goodness of fit. McCain (1990), explains that "stress will decrease and correlations will increase with increasing number or dimensions". The ALSCAL procedures uses the Kruskal Stress Formula 1 as its algorithm (SPSS, 1988). In general the stress value (STRESS) and the corresponding squared correlation coefficient (RSQ) shows the fit of the data. A low STRESS (between 0 and 1) and a high RSQ (between 0 and 1) depict a good fit between the data and the solution.

IV. DESCRIPTIVE FINDINGS (FACTOR ANALYSIS)

A. INTRODUCTION

The findings described in the section below reflect those from research done by Lockhart (1992) and Hurd (1991). These findings are based on the statistical methods of factor analysis of data collected from the Naval Hospital at Charleston, Camp Lejeune and Jacksonville. Once these findings have been described, the findings resulting from multidimensional scaling will be described in Chapter V.

B. DEMOGRAPHIC FINDINGS BY LOCATION AND AS A GROUP (FACTOR ANALYSIS)

Of the three Naval hospitals surveyed by Hurd (1991) and Lockhart (1992), 101 usable questionnaires were obtained from Naval Hospital Charleston, 121 from Naval Hospital Camp Lejeune and 118 from the Naval Hospital Jacksonville. The response rates for the Naval Hospitals Charleston, Camp Lejeune and Jacksonville were 56%, 48% and 47%, respectively. Appendix B contains a summary of the demographics by location and as a group (the three hospitals combined).

1. Age

Hurd's (1991) data revealed an average age of respondents from the Naval Hospital Charleston to be 32 years, with a range in years from 19 to 56. Lockhart's (1992)

data revealed the average age of respondents from the Naval Hospital Camp Lejeune was 33 years, with a range in years from 18 to 61. The average age of respondents from the Naval Hospital Jacksonville was 32 years, with a range in years from 19 to 56. The combined group had an average age of 32 years with a range in years from 18 to 61 (Lockhart, 1992).

2. Gender

The gender of the respondents from the Naval Hospital Charleston were 57 (56%) male and 44 (44%) female. The gender of the respondents from the Naval Hospital Camp Lejeune were 73 (60%) male and 48 (40%) female. The gender of the respondents from the Naval Hospital Jacksonville were 83 (70%) male and 35 (30%) female. The gender split in the combined group of respondents were 213 (63%) male and 127 (37%) female (Lockhart, 1992).

3. Hospital Departments

Only outpatient departments were sampled. Work areas reported were in one of the following department types: clinic, administration, laboratory, pharmacy, or radiology. Figure 4.1 depicts the individual and combined hospital department types and percentages.

4. Job Descriptions

Job descriptions reported were categorized into one of the following types:

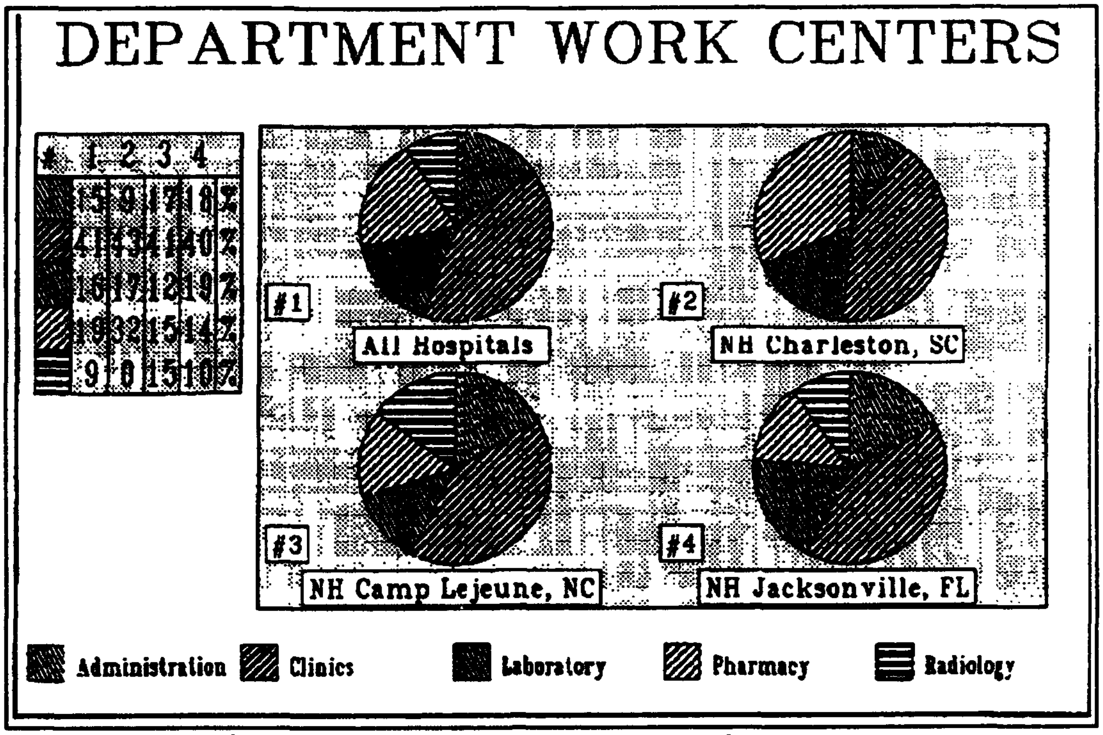

Figure 4.1. Department Work Centers

- Physician - a Medical Corps Officer or civilian equivalent.
- Nurse - a Nurse Corps Officer or civilian equivalent.
- Health Professional - a Medical Service Corps Officer (Allied Science) or civilian equivalent.
- Administrator - a Medical Service Corps Officer (Health Care Administration) or civilian equivalent.
- Technician - a Hospital Corpsman with a medical technician rating or civilian equivalent.
- Corpsman - a Hospital Corpsman without a technical rating.
- Clerical - a person performing secretarial or clerical functions.

Figure 4.2 depicts the individual and combined hospital job description types and percentages.

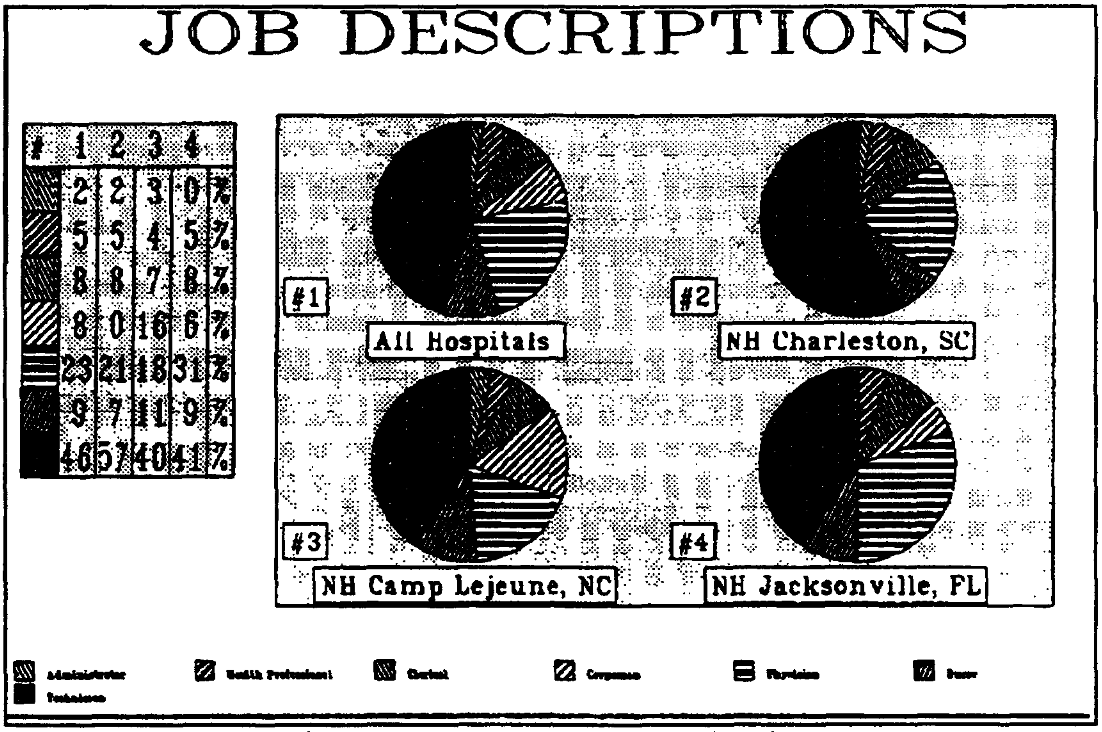

Figure 4.2. Job Description

5. Functional User Groups

Respondents were categorized into three functional work groups based on their work department and job description types: Physicians, Medical Support, and Administrative Support. The Physician group is self explanatory. The Medical Support group consisted of: nurses, health professionals, technicians, and corpsman not working in an administrative department. The Administrative Support group consisted of: all administrators, and clerical persons regardless of department assigned to, and all other persons regardless of profession assigned to an administrative department. Figure 4.3 depicts the individual and combined hospital user group types and percentages.

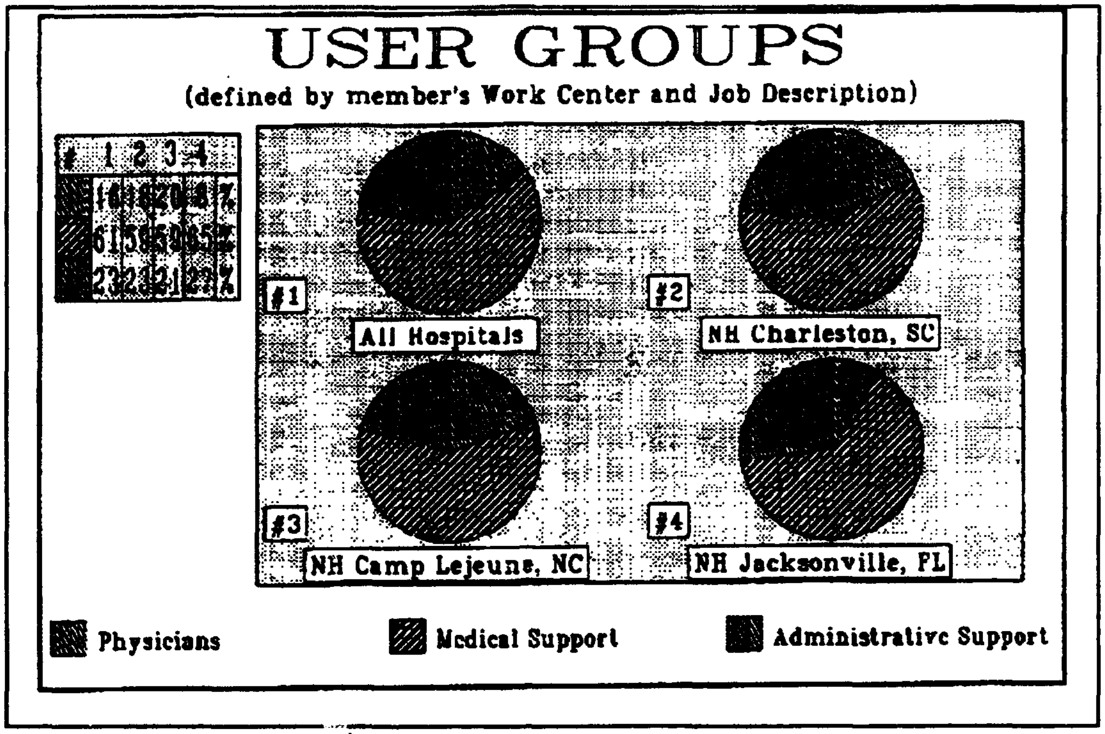

Figure 4.3. User Groups

6. Level of Education

Looking at the combined hospital data, Figure 4.4, almost 90% of the respondents have some college or higher educational experience. The median education level of the respondents from the Naval Hospital Charleston and from the Naval Hospital Camp Lejeune was "some college." The median education level of the respondents from the Naval Hospital Jacksonville was "bachelor degree." The median education level of the combined group was "some college." Figure 4.4 depicts the individual and combined hospital level of education and percentages.

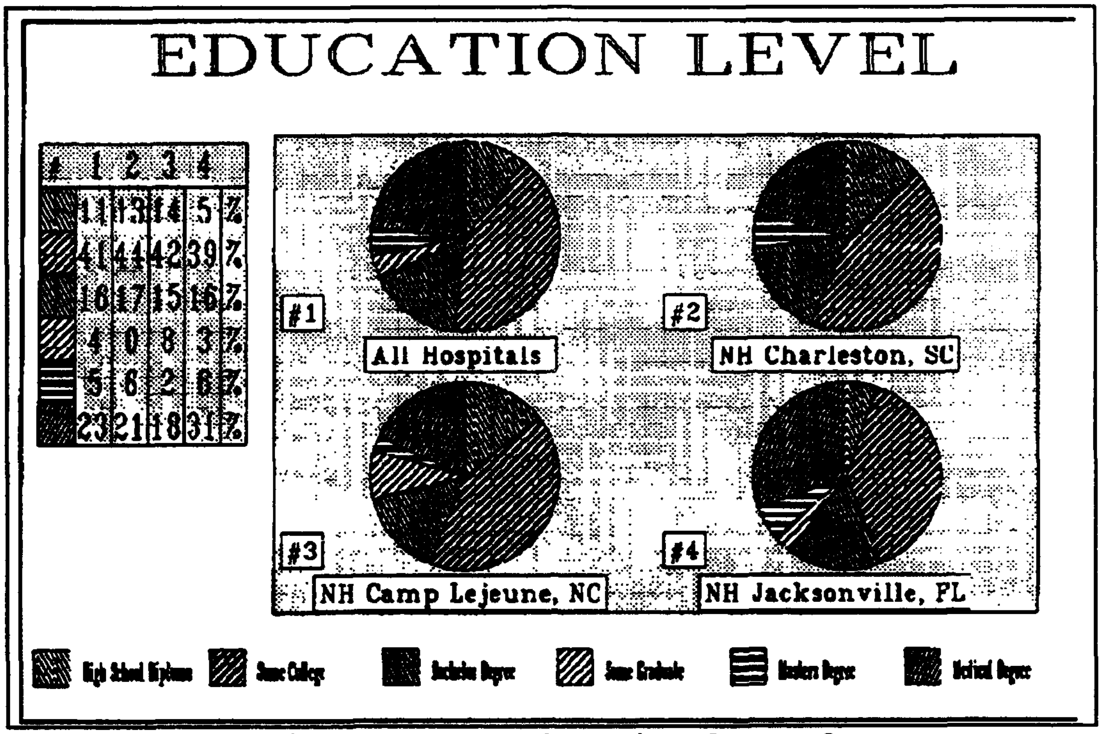

Figure 4.4. Educational Level

7. Computer Use

Computer use is a task for this group of participants. 80% of all the participants have used other computer systems. Of these users, nearly three quarters (74%) have used other health care information systems. When comparing all respondents, 59% have used other health care information systems (HCIS). The respondents from the Naval Hospital Charleston reported a 80% use of other computer systems; of those users, 71% have used a HCIS and of all respondents, 58% have used a HCIS. The respondents from the Naval Hospital Camp Lejeune reported a 76% use of other computer systems; of those users, 68% have used a HCIS and of all respondents, 52% have use a HCIS. The respondents from the Naval Hospital

Jacksonville reported a 86% use of other computer systems; of those users, 76% have used a HCIS and of all respondents, 66% have used a HCIS.

8. Length of Time of CHCS Use

Of all respondents, the average length of time in months of use of the CHCS was 12.3 months. The overall time of use ranged from one month to 36 months. The respondents from the Naval Hospital Charleston reported an average time of use of 8.6 months, with a range of one to 19 months. The respondents from the Naval Hospital Camp Lejeune reported an average time of use of 12.5 months, with a range of one to 36 months. The respondents from the Naval Hospital Jacksonville reported an average time of use of 15.3 months, with a range of one to 32 months.

C. VALIDATION OF THE INSTRUMENT

1. Homogeneity of the Sample Data Sets

One way ANOVA results are presented in Table 4.1a. Significant differences in means are indicated by underlining. Significant differences in subpopulation means were noted in the education and the time of use of CHCS user attributes.

TABLE 4.1A
USER ATTRIBUTES ANOVA TESTING

ATTRIBUTE	F VALUE	P VALUE	NSCORES CORRELATION	HARTLEY FMAX(1)
AGE	0.16	0.852	0.98	1.59
GENDER	2.48	0.086	0.88	1.18
COMPUTER SYSTEM EXPERIENCE	2.18	0.115	0.81	1.55
HOSPITAL INFORMATION SYSTEM EXPERIENCE	2.45	0.088	0.89	1.11
EDUCATION	4.09	0.018	0.93	1.17

Note:
(1) Hartley's $Fmax_{(3,110)}$ approximate critical value = 1.803, alpha = 0.05

The Scheffe interval comparison testing for the education attribute is presented in Table 4.1b. Education was tested and found to have no significant correlation with the overall satisfaction, as well as with each of the four factors found when factor analysis was performed. Time of use of the CHCS system is discussed later in this paper.

TABLE 4.1B
SCHEFFE MULTIPLE COMPARISON TESTING OF EDUCATION ATTRIBUTE

	SITE LOCATION COMPARISONS		
USER ATTRIBUTE	CHARLESTON/ CAMP LEJEUNE	CHARLESTON/ JACKSONVILLE	CAMP LEJEUNE/ JACKSONVILLE
EDUCATION	NS(1)	NS(1)	S(2)

NOTES:
(1) NS = nonsignificant; no difference between the means
(2) S = significant difference between the means

2. Exploratory Factor Analysis

The combined data set (n=340) was used to perform the exploratory factor analysis procedure. The Cattell Scree Test suggested a maximum of five factors may possibly exist. The SAS maximum likelihood factor analysis procedure was written

to sequentially perform a one-factor solution through a five-factor solution. Kaiser's Measure of Sampling Adequacy (MSA) had a value of 0.89 indicating a good fit of the data for factor analysis. The maximum likelihood factor analysis procedure in SAS uses squared multiple correlations (SMC) as its initial starting estimate. The SMC is the lower bound for the reliability of each variable. The SAS squared canonical correlations (SCC) reported for each factor is the lower bound of reliability for that factor from the variables that make up that factor (SAS, 1989). The one-factor solution made up of all 13 questions had a SCC value of 0.90.

Schwartz's Bayesian Criterion (SBC) value kept decreasing for the two-factor and the three-factor solutions. This indicated that a *greater than* three-factor solution was optimal. The three-factor solution had a SBC of 219 and a Tucker and Lewis's Reliability Coefficient of 0.91. At the four-factor solution, the SBC reached its lowest value of 211, and rose to the value of 217 at the five-factor solution. Table 4.2 shows the optimal four factor solution. Tucker and Lewis' Reliability Coefficient was 0.95 for the four-factor solution.

Factor A is made up of questions 1, 6, and 11, and represents the local Management Information Department (MID) staff and services. Factor B is made up of questions 2, and 12, and represents the contractor's services. Factor C is made up of questions 7, 8, 9, 10, and 13, and represents the

information product output. Factor D is made up of questions 3, 4, and 5, and represents user knowledge and involvement.

3. Confirmatory Factor Analysis

Paramount to the maximum likelihood factor analysis procedure is that the data be multivariate normal. There is no easily defined test for multivariate normality that could be found in the literature. Instead, the Jõreskog and Sõrbom's (1989) LISREL model for analysis of non-normal variables was used. The Total Coefficient of Determination (TCD) for the variables was 0.997 indicating a very good fit to the four-factor solution. Other goodness of fit indices used supported the four-factor solution. The Goodness of Fit Index (GFI) was 0.985, and the Adjusted Goodness of Fit Index (AGFI) was 0.977.

The Root Mean Square Residual (RMR) was 0.041, which also supports the goodness of fit of the four-factor solution. Additionally, Standard Errors (SE) and t-values (LISREL'S critical ratios) were performed for each of the variables's loading into their respective factor. The SE's were all low (<0.04), and the t-values were all large (>20) for each of variable factor loadings, which further supports the goodness of fit of the four-factor solution.

4. Reliability (Internal Consistency) Testing

Factor A is made up of questions 1, 6, and 11, and represents the local Management Information Department (MID)

staff and services. Factor B is made up of questions 2, and 12, and represents the contractor's services. Factor C is made up of questions 7, 8, 9, 10, and 13, and represents the information product. Factor D is made up of questions 3, 4, and 5, and represents knowledge and involvement.

The Cronbach's alpha for factor A was 0.89; for factor B was 0.68; for factor C was 0.87; and for factor D was 0.75.

TABLE 4.2
MAXIMUM LIKELIHOOD FACTOR ANALYSIS WITH VARIMAX ROTATION

QUESTIONS/VARIABLES	FACTOR A	FACTOR B	FACTOR C	FACTOR D	SMC
1. RELATIONSHIP WITH MID STAFF	<u>0.75</u>	0.18	0.18	0.20	0.61
2. PROCESSING OF REQUESTS FOR CHANGES	0.12	<u>0.58</u>	0.19	0.16	0.36
3. DEGREE OF TRAINING PROVIDED	0.27	0.34	0.16	<u>0.48</u>	0.43
4. USER'S UNDERSTANDING OF SYSTEM	0.16	0.11	0.10	<u>0.79</u>	0.37
5. USER'S FEELING OF PARTICIPATION	0.25	0.32	0.30	<u>0.51</u>	0.48
6. ATTITUDES OF MID STAFF	<u>0.79</u>	0.14	0.20	0.15	0.63
7. RELIABILITY OF OUTPUT	0.16	0.25	<u>0.77</u>	0.07	0.61
8. RELEVANCY OF OUTPUT	0.23	0.32	<u>0.61</u>	0.15	0.54
9. ACCURACY OF OUTPUT	0.20	0.15	<u>0.75</u>	0.09	0.56
10. PRECISION OF OUTPUT	0.12	0.05	<u>0.71</u>	0.19	0.48
11. COMMUNICATING WITH MID STAFF	<u>0.83</u>	0.14	0.22	0.19	0.69
12. TIME REQUIRED FOR NEW DEVELOPMENT	0.17	<u>0.69</u>	0.23	0.19	0.45
13. COMPLETENESS OF OUTPUT	0.20	0.44	<u>0.59</u>	0.10	0.57
Eigenvalue	4.10	2.30	15.90	1.30	–
Cumulative Percent	17%	26%	94%	100%	–
SCC	0.80	0.70	0.94	0.56	–
Cronbach's Alpha	0.89	0.68	0.87	0.75	–

Schwartz Bayesian Criterion = 211
Tucker and Lewis Reliability Coefficient = 0.95

5. Testing for Measurement and Structural Invariance

The use of Jõreskog and Sõrbom's LISREL model to test for measurement and structural invariance revealed that the three subpopulations are equivalent for their responses and the four-factor data reduction. Hypothesis A was that the covariance structure across the three subpopulations is invariant. Hypothesis B was that the number of factors of the factor structure is the same across the three subpopulations is invariant. Hypothesis C was that the factor loading pattern across the three subpopulations is invariant. Hypothesis D was that the error/uniqueness structure is invariant across the three subpopulations. Hypothesis E was that the factor variances and covariances are invariant across the three subpopulations.

As mentioned previously in Chapter III, the chi-square/degrees of freedom ratio is distributed as a t-statistic so that anything greater than 1.96 is significant and therefore would reject the null hypothesis of invariance. Table 4.3 shows the results.

TABLE 4.3
EQUIVALENCE TESTING

HYPOTHESIS	χ^2	df	χ^2/df	LR Test
A: COVARIANCE STRUCTURE IS THE SAME	242.2	182	1.33	–
B: NUMBER OF FACTORS IS THE SAME	331.2	177	1.87	–
C: FACTOR LOADING IS THE SAME	341.0	. 195	1.75	0.55
D: THE ERROR/UNIQUENESS IS THE SAME	383.6	221	1.74	1.19
E: FACTOR VARIANCES AND COVARIANCES ARE THE SAME	394.5	241	1.64	0.99

6. **Post Survey Interviews (Convergent Validity)**

During the one-day visits to the Naval Hospitals Camp Lejeune and Jacksonville, time constraints limited the number if individuals that were interviewed to a total of 15 (approximately 5% of the total sample population). In working around individual work schedules, an equal distribution of interviews was obtained. Of the total 15 interviews, three were with physicians, three with administrative personnel, three with clinic personnel, three with laboratory personnel, and three with pharmacy personnel. During the interviews, the individuals were asked about their overall impression of satisfaction (satisfied or dissatisfied), and to comment about the system. All individuals interviewed had at least nine-months experience with the CHCS. Between interviews, there was an opportunity for first-hand use of the CHCS at the Naval Hospital Camp Lejeune's training room.

The majority of the physicians (2 out of 3) were overall dissatisfied with the CHCS. They cited a cumbersome menu interface, slow response time of the system, and slow response time to change the system. The clinic, administrative, laboratory and pharmacy personnel interviewed expressed they were satisfied, but also echoed the same comments as the physicians.

Other general comments offered about the survey instrument were: 1) provide an example--the bipolar

adjective pairs tended to confuse some and 2) the instrument did not address how the user interacted or put information into the system.

D. EVALUATION OF THE INSTRUMENT'S DATA

1. Testing Differences in Means

The combined three hospital data set was used to test the difference in means between the three user groups for each of the 13 questions, overall score, and factors. Using the combined data set, each user group was tested form differences in means between the three location sites (i.e., Charleston vs Camp Lejeune vs Jacksonville). Lastly, each hospital's data was tested for differences in means between the three user groups. Figure 4.5 shows the level of satisfaction for each of the 13 questions and by each user group.

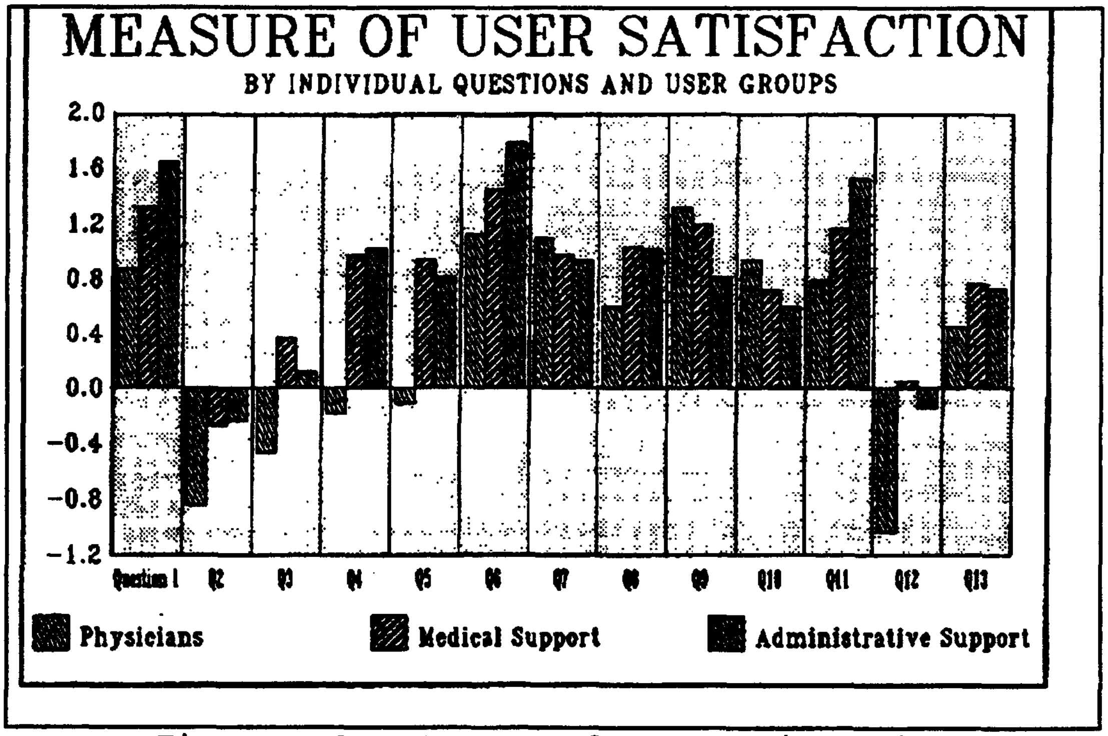

Figure 4.5. Measure of User Satisfaction

a. Combined Hospital Data

(1) Differences Between User Groups. Table 4.4A shows the ANOVA testing results between user groups. significant findings (at alpha = 0.05) are underlined. The Physician group sample size consisted of 79 participants; the Medical Support group consisted of 207 participants; and the Administrative Support group consisted of 54 participants. The *a posteriori* testing for normality via the NSCORES correlation demonstrates that the data has a normal distribution.

Except for questions 9 and 10, the Hartley Fmax test revealed homogeneity of variance between groups. Questions 9

and 10 were tested using the Kruskal-Wallis nonparametric ANOVA testing of sample medians. The nonparametric findings also showed no significant difference in medians. Questions 7, 8, 9, 10, and 13 which make up Factor C (information product output) revealed no significant differences. Factor C across the three user groups means were within the "slightly satisfied" range (0 to 1).

TABLE 4.4A
COMBINED HOSPITALS ANOVA TESTING; USER GROUPS

QUESTIONS/FACTORS	USER GROUP MEANS (1)			F VALUE	P VALUE	NSCORES CORRELATION	HARTLEY FMAX(2)
	P	M	A				
1. RELATIONSHIP WITH MID STAFF	0.88	1.32	1.65	6.22	0.002	0.98	1.12
2. PROCESSING OF REQUESTS FOR CHANGE	-0.85	-0.28	-0.24	4.02	0.019	0.98	1.54
3. DEGREE OF TRAINING	-0.47	0.39	0.12	7.23	0.001	0.99	1.34
4. USER'S UNDERSTANDING OF SYSTEM	-0.19	0.98	1.03	16.33	0.000	0.98	1.17
5. USER'S FEELING OF PARTICIPATION	-0.11	0.94	0.81	14.24	0.000	0.98	1.17
6. ATTITUDE OF MID STAFF	1.12	1.45	1.79	4.37	0.013	0.98	1.13
7. RELIABILITY OF OUTPUT	1.10	0.98	0.94	0.29	0.752	0.97	1.41
8. RELEVANCY OF OUTPUT	0.60	1.04	1.02	2.94	0.054	0.97	1.11
9. ACCURACY OF OUTPUT	1.32	1.20	0.81	2.43	0.089	0.97	2.08
10. PRECISION OF OUTPUT	0.94	0.72	0.60	1.26	0.285	0.98	2.01
11. COMMUNICATION WITH MID STAFF	0.79	1.17	1.53	4.99	0.007	0.98	1.35
12. TIME REQUIRED FOR NEW DEVELOPMENT	-1.04	0.05	-0.15	13.05	0.000	0.99	1.26
13. COMPLETENESS OF OUTPUT	0.[illegible]5	0.77	0.73	1.28	0.279	0.98	1.16
OVERALL SCORE	4.54	10.71	10.62	7.31	0.001	0.99	1.69
A. MID STAFF AND SERVICES	0.93	1.31	1.66	6.49	0.002	0.98	1.15
B. CONTRACT SERVICES	-0.95	-0.12	-0.19	10.45	0.000	0.99	1.35
C. INFORMATION OUTPUT	0.88	0.94	0.82	0.26	0.772	0.98	1.61
D. KNOWLEDGE AND INVOLVEMENT	-0.26	0.77	0.65	18.70	0.000	0.99	1.28

NOTES:
(1) P = Physicians; M = Medical Support; A = Administrative Support
(2) Hartley's $Fmax_{3,120}$ approximate critical value = 1.80 at alpha = 0.05

(2) Significant User Group Findings. Table 4.4B represents those items where the ANOVA testing in Table 4.4A revealed a significant difference in the means between the user groups. Scheffe multiple comparison testing was used to

identify the individual differences between user groups. Physicians were less satisfied and displayed a significant difference between the other two user groups in virtually all the individual questions that make up Factor A, Factor B and Factor D.

TABLE 4.4B
SCHEFFE MULTIPLE COMPARISON TESTING; USER GROUPS

QUESTIONS/FACTORS	USER GROUPS COMPARISON		
	PHYSICIAN/ MEDICAL SUPPORT	PHYSICIAN/ ADMIN SUPPORT	MEDICAL SUPPORT/ ADMIN SUPPORT
1. RELATIONSHIP WITH MID STAFF	S(1)	S	NS(2)
2. PROCESSING OF REQUESTS FOR CHANGES	S	NS	NS
3. DEGREE OF TRAINING PROVIDED	S	NS	NS
4. USER'S UNDERSTANDING OF SYSTEM	S	S	NS
5. USER'S FEELING OF PARTICIPATION	S	S	NS
6. ATTITUDES OF MID STAFF	NS	S	NS
11. COMMUNICATING WITH MID STAFF	NS	S	NS
12. TIME REQUIRED FOR NEW DEVELOPMENT	S	S	NS
OVERALL SCORE	S	S	NS
A. MID STAFF AND SERVICES	S	S	NS
B. CONTRACTOR SERVICES	S	S	NS
D. KNOWLEDGE AND INVOLVEMENT	S	S	NS

NOTES:
(1) S = Significant difference in means
(2) NS = Nonsignificant; no difference in means

(3) Physician Group Differences by Site. Table 4.5A shows the ANOVA testing results for Physician user group between the three Naval Hospital (NH) sites. Significant findings (at an alpha of 0.05) are underlined. The Physician group sample size at the NH Charleston consisted of 21

participants; NH Camp Lejeune consisted of 22 participants; and NH Jacksonville consisted of 36 participants. The *a posteriori* testing for normality via the NSCORES correlation demonstrates that the data has a normal distribution. Except for questions 7 and 13, the Hartley Fmax test revealed homogeneity of variance between the groups. Questions 7 and 13 were tested using the Kruskal-Wallis nonparametric ANOVA testing of sample medians. The nonparametric findings also showed no significant difference in medians.

Questions 7, 8, 9, 10, and 13 which make up Factor C revealed no significant differences. Factor C across the three sites for Physician group were essentially within the "slightly satisfied" range (0 to 1). Other nonsignificant differences in means were found for questions 4 and 12. Questions 4 and 12 both were essentially within the "slightly dissatisfied" range (-1 to 0), and help make up Factors D and B, respectively.

TABLE 4.5A
PHYSICIAN GROUP ANOVA TESTING

QUESTIONS/FACTORS	LOCATION SITE MEANS (1)			F VALUE	P VALUE	NSCORES CORRELATION	HARTLEY FMAX(2)
	CH	CL	JX				
1. RELATIONSHIP WITH MID STAFF	1.38	1.36	0.29	9.23	0.000	0.98	1.70
2. PROCESSING OF REQUESTS FOR CHANGE	-0.45	-0.05	-1.60	8.81	0.000	0.98	1.45
3. DEGREE OF TRAINING	0.05	0.05	-1.08	5.99	0.004	0.99	1.48
4. USER'S UNDERSTANDING OF SYSTEM	0.14	-0.59	-0.14	1.26	0.289	0.98	1.23
5. USER'S FEELING OF PARTICIPATION	0.55	-0.21	-0.44	3.49	0.035	0.97	1.69
6. ATTITUDE OF MID STAFF	1.57	1.77	0.46	12.06	0.000	0.97	1.72
7. RELIABILITY OF OUTPUT	1.07	1.32	0.99	0.47	0.625	0.95	3.13
8. RELEVANCY OF OUTPUT	0.57	0.71	0.54	0.09	0.913	0.96	1.10
9. ACCURACY OF OUTPUT	1.41	1.50	1.17	0.80	0.451	0.97	1.98
10. PRECISION OF OUTPUT	0.86	0.86	1.04	0.32	0.728	0.98	1.76
11. COMMUNICATION WITH MID STAFF	1.36	1.34	0.13	13.61	0.000	0.99	1.40
12. TIME REQUIRED FOR NEW DEVELOPMENT	-0.93	-0.52	-1.42	2.61	0.075	0.98	1.15
13. COMPLETENESS OF OUTPUT	0.52	0.84	0.17	1.51	0.227	0.98	5.07
OVERALL SCORE	8.10	8.39	0.11	7.21	0.001	0.97	1.68
A. MID STAFF AND SERVICES	1.44	1.49	0.29	14.69	0.001	0.98	1.24
B. CONTRACT SERVICES	-0.69	-0.28	-1.50	7.38	0.001	0.99	1.74
C. INFORMATION OUTPUT	0.86	1.04	0.78	0.51	0.605	0.97	2.14
D. KNOWLEDGE AND INVOLVEMENT	0.25	-0.25	-0.56	3.23	0.045	0.99	2.05

NOTES:
(1) CH = NH Charleston; CL = NH Camp Lejeune; JX = NH Jacksonville
(2) Hartley's $Fmax_{(3,27)}$ approximate critical value = 2.57 at alpha = 0.05

(4) Significant Physician Group Findings. Table 4.5B represents those items where the ANOVA testing in Table 4.5A revealed a significant difference in the means between the Physician groups. Scheffe multiple comparison testing was used to identify the individual differences between sites.

Physicians at the NH Jacksonville were less satisfied and displayed a significant difference between the other two sites in all the individual questions (1, 6, and 11) that make up Factor A (MID Staff and Services). The NH Charleston and the NH Camp Lejeune Factor A findings were within the "quite satisfied" range (1 to 2) versus the NH Jacksonville's findings within the "slightly satisfied" range (0 to 1).

Physicians at the NH Jacksonville were less satisfied and displayed a significant difference between the other two sites for Factor B (Contractor Services; questions 2 and 12). Physicians at the NH Jacksonville were less satisfied as compare with the NH Charleston with Factor D, but demonstrated no difference between the NH Camp Lejeune. The NH Jacksonville, and the NH Camp Lejeune findings for Factor D were within the "slightly dissatisfied" range (-1 to 0) verses the NH Charleston's findings within the "slightly satisfied" range (0 to 1).

TABLE 4.5B
SCHEFFE MULTIPLE COMPARISON TESTING; PHYSICIAN GROUP

QUESTIONS/FACTORS	LOCATION SITE COMPARISON		
	CHARLESTON/ CAMP LEJEUNE	CHARLESTON/ JACKSONVILLE	CAMP LEJEUNE/ JACKSONVILLE
1. RELATIONSHIP WITH MID STAFF	NS(1)	S(2)	S
2. PROCESSING OF REQUESTS FOR CHANGES	NS	S	S
3. DEGREE OF TRAINING PROVIDED	NS	S	S
5. USER'S FEELING OF PARTICIPATION	NS	S	NS
6. ATTITUDES OF MID STAFF	NS	S	S
11. COMMUNICATION WITH MID STAFF	NS	S	S
OVERALL SCORE	NS	S	S
A. MID STAFF AND SERVICES	NS	S	S
B. CONTRACTOR SERVICES	NS	S	S
D. KNOWLEDGE AND INVOLVEMENT	NS	S	NS

NOTES:
(1) NS = Nonsignificant; no difference in means
(2) S = Significant difference in means

(5) Medical Support Group Differences by Site. Table 4.6A shows the ANOVA testing results for Medical Support user group between the three naval hospital sites. Significant findings (at alpha = 0.05) are underlined. The Medical Support group sample size at the NH Charleston, Camp Lejeune and Jacksonville consisted of 71, 75 and 61 participants respectively. The *a posteriori* testing for normality via the NSCORES correlation demonstrates that the data has a normal distribution. The Hartley Fmax test revealed homogeneity of variance between groups.

Questions 7, 8, 9, 10, and 13 which make up Factor C revealed no significant differences. Factor C across the three user groups means were essentially within the

"slightly satisfied" range (0 to 1). Other nonsignificant differences in means were found for question 4. Question 4 was essentially within the "slightly dissatisfied" range (0 to -1), and helps make up Factor D.

TABLE 4.6A
MEDICAL SUPPORT GROUP ANOVA TESTING

QUESTIONS/FACTORS	LOCATION SITE MEANS (1)			F VALUE	P VALUE	NSCORES CORRELATION	HARTLEY FMAX(2)
	CH	CL	JX				
1. RELATIONSHIP WITH MID STAFF	1.74	1.22	0.94	6.88	0.001	0.98	1.24
2. PROCESSING OF REQUESTS FOR CHANGE	-0.42	0.24	-0.76	6.79	0.001	0.99	1.69
3. DEGREE OF TRAINING	0.82	0.54	-0.30	7.37	0.001	0.98	1.05
4. USER'S UNDERSTANDING OF SYSTEM	1.33	0.82	0.77	2.58	0.078	0.97	1.42
5. USER'S FEELING OF PARTICIPATION	1.25	0.99	0.53	3.66	0.027	0.98	1.32
6. ATTITUDE OF MID STAFF	2.08	1.33	0.85	16.91	0.000	0.98	1.98
7. RELIABILITY OF OUTPUT	0.80	1.27	0.81	2.34	0.099	0.97	1.48
8. RELEVANCY OF OUTPUT	1.06	1.23	0.76	1.90	0.151	0.98	1.26
9. ACCURACY OF OUTPUT	1.31	1.33	0.91	1.68	0.189	0.97	1.20
10. PRECISION OF OUTPUT	0.58	0.79	0.79	0.53	0.591	0.97	1.22
11. COMMUNICATION WITH MID STAFF	1.73	1.03	0.68	10.92	0.000	0.98	1.64
12. TIME REQUIRED FOR NEW DEVELOPMENT	0.10	0.34	-0.36	3.08	0.048	0.99	1.32
13. COMPLETENESS OF OUTPUT	0.68	0.94	0.67	0.63	0.536	0.98	1.21
OVERALL SCORE	13.06	12.08	6.30	5.02	0.007	0.99	1.23
A. MID STAFF AND SERVICES	1.85	1.20	0.83	14.10	0.000	0.98	1.64
B. CONTRACT SERVICES	-0.16	0.29	-0.56	6.09	0.003	0.99	1.47
C. INFORMATION OUTPUT	0.89	1.11	0.79	1.27	0.284	0.98	1.26
D. KNOWLEDGE AND INVOLVEMENT	1.13	0.76	0.33	6.36	0.002	0.99	1.29

NOTES:
(1) *CH = NH Charleston; CL = NH Camp Lejeune; JX = NH Jacksonville*
(2) Hartley's $Fmax_{(3,40)}$ approximate critical value = 1.84 at alpha = 0.05

(6) Significant Medical Support Group Findings. Table 4.6A represents those items where the ANOVA testing in TABLE 4.6A revealed a significant difference in the means between the Medical Support groups. Scheffe multiple comparison testing was used to identify the individual differences between sites.

For Factor A, the NH Charleston was significantly different from the other two sites. In each of the individual questions the NH Charleston was more satisfied ("quite satisfied" range of 1 to 2) than the two sites which were within the "slightly satisfied" range.

For Factor B, the NH Jacksonville was less satisfied when compared with the NH Camp Lejeune, but had no significant difference between the NH Charleston. Both the NH Jacksonville and Charleston findings for Factor B were within the "slightly dissatisfied" range (0 to -1), whereas the NH Camp Lejeune findings for Factor B were within the "slightly satisfied" range (0 to 1). Even though the NH at Charleston and Camp Lejeune have opposing findings for Factor B, they were still statistically nonsignificant for differences between their respective means.

For Factor D, the NH Jacksonville scored less satisfied findings as compared with the NH Charleston, but no significant difference between the NH Camp Lejeune. However, all three sites for Factor D scored within essentially the "slightly satisfied" range (0 to 1).

TABLE 4.6B
SCHEFFE MULTIPLE COMPARISON TESTING; MEDICAL SUPPORT GROUP

QUESTIONS/FACTORS	LOCATION SITE COMPARISONS		
	CHARLESTON/ CAMP LEJEUNE	CHARLESTON/ JACKSONVILLE	CAMP LEJEUNE/ JACKSONVILLE
1. RELATIONSHIP WITH MID STAFF	S(1)	S	NS(2)
2. PROCESSING OF REQUESTS FOR CHANGES	NS	NS	S
3. DEGREE OF TRAINING PROVIDED	NS	S	S
5. USER'S FEELING OF PARTICIPATION	NS	S	NS
6. ATTITUDES OF MID STAFF	S	S	NS
11. COMMUNICATION WITH MID STAFF	S	S	NS
12. TIME REQUIRED FOR NEW DEVELOPMENT	NS	NS	NS
OVERALL SCORE	NS	S	S
A. MID STAFF AND SERVICES	S	S	NS
B. CONTRACTOR SERVICES	NS	NS	S
D. KNOWLEDGE AND INVOLVEMENT	NS	S	NS

NOTES:
(1) S = Significant difference in means
(2) NS = Nonsignificant; no difference in means

(7) Administrative Group Differences by Site. Table 4.7A shows the ANOVA testing results for Administrative Support user group between the three hospital sites. Significant findings (at alpha = 0.05) are underlined. The Administrative Support group sample size as NH Charleston, Camp Lejeune and Jacksonville consisted of 9, 24, and 21 participants, respectively. The a *posteriori* testing for normality via NSCORES correlation demonstrates that the data has a normal distribution. Except for Factor B, the Hartley Fmax test revealed homogeneity of variance between groups.

Factor B was tested using the Kruskal-Wallis nonparametric ANOVA testing of sample medians. The

nonparametric findings showed significant difference in medians (P value = 0.01). However, the Mann-Whitney non parametric pairwise comparisons were the same as the Scheffe parametric findings shown in Table 4.7b. Factor D was nonsignificant for differences in means between the sites with a score in the "slightly satisfied" range (0 to 1).

TABLE 4.7A
ADMINISTRATIVE SUPPORT GROUP ANOVA TESTING

QUESTIONS/FACTORS	LOCATION SITE MEANS (1)			F VALUE	P VALUE	NSCORES CORRELATION	HARTLEY FMAX(2)
	CH	CL	JX				
1. RELATIONSHIP WITH MID STAFF	1.89	2.19	0.93	7.22	0.002	0.97	1.67
2. PROCESSING OF REQUESTS FOR CHANGE	-1.28	0.25	-0.36	5.04	0.010	0.97	1.52
3. DEGREE OF TRAINING	-0.11	0.50	-0.21	1.20	0.308	0.99	1.74
4. USER'S UNDERSTANDING OF SYSTEM	0.00	1.33	1.22	2.24	0.117	0.98	1.41
5. USER'S FEELING OF PARTICIPATION	0.89	1.31	0.19	3.35	0.043	0.99	1.74
6. ATTITUDE OF MID STAFF	2.22	2.42	0.88	13.87	0.000	0.96	1.85
7. RELIABILITY OF OUTPUT	0.06	1.27	0.93	2.91	0.064	0.98	1.52
8. RELEVANCY OF OUTPUT	1.00	1.35	0.64	1.60	0.212	0.97	1.44
9. ACCURACY OF OUTPUT	-0.50	1.44	0.64	7.85	0.001	0.98	1.49
10. PRECISION OF OUTPUT	-0.44	1.08	0.50	5.17	0.009	0.98	2.21
11. COMMUNICATION WITH MID STAFF	1.72	2.17	0.71	8.55	0.001	0.97	1.14
12. TIME REQUIRED FOR NEW DEVELOPMENT	-1.06	0.13	-0.07	1.83	0.171	0.99	1.48
13. COMPLETENESS OF OUTPUT	0.06	1.04	0.67	1.56	0.220	0.98	1.29
OVERALL SCORE	4.44	16.48	6.57	5.89	0.005	0.99	1.68
A. MID STAFF AND SERVICES	1.95	2.26	0.84	12.09	0.000	0.97	1.24
B. CONTRACT SERVICES	-1.17	0.19	-0.21	4.34	0.018	0.99	1.74
C. INFORMATION OUTPUT	0.03	1.24	0.68	4.66	0.014	0.98	1.56
D. KNOWLEDGE AND INVOLVEMENT	0.26	1.05	0.37	2.04	0.141	0.99	1.19

NOTES:
(1) CH = NH Charleston; CL = NH Camp Lejeune; JX = NH Jacksonville
(2) Hartley's $Fmax_{(3,17)}$ approximate critical value = 3.30 at alpha = 0.05

(8) Significant Administrative Support Group Findings. Table 4.7B represents those items where the ANOVA testing in Table 4.7A revealed a significant difference in the means between the Administrative Support groups. Scheffe multiple comparison testing was used to identify the individual differences between sites.

The Administrative Support group at the NH Jacksonville for Factor A were less satisfied than the other two sites. The NH at Camp Lejeune and Jacksonville were both within the "quite satisfied" range (1 to 2), whereas the NH Jacksonville was within the "slightly satisfied" range (0 to 1).

The NH Charleston for Factor B was less satisfied than the other two sites. The NH Camp Lejeune for Factor B was within the "slightly satisfied" range (0 to 1), and the NH Jacksonville was within the "slightly dissatisfied" range (0 to -1), but was not statistically different. The NH Charleston for Factor B was within the "quite dissatisfied" range (-1 to -2).

For Factor C, the NH Charleston was less satisfied compared with the NH Camp Lejeune, however, scored no difference with the NH Jacksonville. The significant influences to this finding was the significant differences paralleled with questions 9 and 10 dealing with output accuracy and precision. Both the NH Camp Lejeune and the NH

Jacksonville were essentially within the "slightly satisfied" range (0 to 1) for Factor C, whereas, the NH Charleston was "neutral" with a zero score.

TABLE 4.7B
SCHEFFE MULTIPLE COMPARISON TESTING; ADMIN SUPPORT GROUP

QUESTIONS/FACTORS	LOCATION SITE COMPARISONS		
	CHARLESTON/ CAMP LEJEUNE	CHARLESTON/ JACKSONVILLE	CAMP LEJEUNE/ JACKSONVILLE
1. RELATIONSHIP WITH MID STAFF	NS(1)	NS	S(2)
2. PROCESSING OF REQUESTS FOR CHANGES	S	NS	NS
5. USER'S FEELING OF PARTICIPATION	NS	NS	S
6. ATTITUDES OF MID STAFF	NS	S	S
9. ACCURACY OF OUTPUT	S	NS	NS
10. PRECISION OF OUTPUT	S	NS	S
11. COMMUNICATION WITH MID STAFF	NS	NS	S
OVERALL SCORE	S	NS	S
A. MID STAFF AND SERVICES	NS	S	S
B. CONTRACTOR SERVICES	S	S	NS
C. INFORMATION OUTPUT	S	NS	NS

NOTES:
(1) NS = Nonsignificant; no difference in means
(2) S = Significant difference in means

b. The Naval Hospital Charleston

(1) Differences between User Groups. Table 4.8A shows the ANOVA testing results between user groups. Significant findings (at alpha = 0.05) are underlined. The Physician group sample size consisted of 21 participants; the Medical Support group consisted of 71 participants; and the Administrative Support group consisted of 9 participants. The *a posteriori* testing for normality via the NSCORES correlation demonstrates that the data has a normal distribution. The

disparity in the size of the user groups sample sizes lead to reject homogeneity of variance in a number of questions. However, on subsequent testing using nonparametric procedures revealed essentially the same results and patterns.

TABLE 4.8A
NH CHARLESTON USER GROUP ANOVA TESTING

QUESTIONS/FACTORS	USER GROUP MEANS (1)			F VALUE	P VALUE	NSCORES CORRELATION	HARTLEY FMAX(2)
	P	M	A				
1. RELATIONSHIP WITH MID STAFF	1.38	1.74	1.89	0.84	0.433	0.98	1.38
2. PROCESSING OF REQUESTS FOR CHANGE	-0.45	-0.42	-1.28	1.08	0.345	0.99	<u>2.48</u>
3. DEGREE OF TRAINING	0.05	0.82	-0.11	2.49	0.088	0.98	1.98
4. USER'S UNDERSTANDING OF SYSTEM	0.14	1.33	0.00	<u>6.99</u>	<u>0.001</u>	0.98	1.39
5. USER'S FEELING OF PARTICIPATION	0.55	1.25	0.89	1.70	0.188	0.97	1.46
6. ATTITUDE OF MID STAFF	1.57	2.08	2.22	2.41	0.095	0.98	1.31
7. RELIABILITY OF OUTPUT	1.07	0.80	0.06	1.53	0.221	0.98	<u>3.99</u>
8. RELEVANCY OF OUTPUT	0.57	1.06	1.00	1.02	0.366	0.98	1.39
9. ACCURACY OF OUTPUT	1.41	1.31	-0.50	<u>6.82</u>	<u>0.002</u>	0.98	<u>2.59</u>
10. PRECISION OF OUTPUT	0.86	0.58	-0.44	2.77	0.068	0.98	<u>3.81</u>
11. COMMUNICATION WITH MID STAFF	1.36	1.73	1.72	0.89	0.413	0.98	1.18
12. TIME REQUIRED FOR NEW DEVELOPMENT	-0.93	0.10	-1.06	<u>4.79</u>	<u>0.010</u>	0.99	1.37
13. COMPLETENESS OF OUTPUT	0.52	0.68	0.06	0.78	0.459	0.99	<u>3.98</u>
OVERALL SCORE	8.10	13.06	4.44	<u>3.22</u>	<u>0.044</u>	0.99	2.19
A. MID STAFF AND SERVICES	1.44	1.85	1.95	1.58	0.211	0.98	1.17
B. CONTRACT SERVICES	-0.69	-0.16	-1.17	<u>3.19</u>	<u>0.045</u>	0.99	<u>3.76</u>
C. INFORMATION OUTPUT	0.89	0.89	0.03	2.23	0.113	0.98	1.85
D. KNOWLEDGE AND INVOLVEMENT	0.25	1.13	0.26	<u>5.79</u>	<u>0.004</u>	0.99	1.22

NOTES:
(1) P = Physicians; M = Medical Support; A = Administrative Support
(2) Hartley's $Fmax_{(3,38)}$ approximate critical value = 2.35 at alpha = 0.05

(2) Significant User Group Findings. Table 4.8B represents those items where the ANOVA testing in Table 4.8A revealed a significant difference in the means between the user groups. Physicians were less satisfied when compared with the Medical Support group for Factor D; no difference with the Administrative Support group. Physicians and the Administrative Support group were within the "slightly satisfied" range (0 to 1). Whereas, the Medical Support group was within the "quite satisfied" range (1 to 2). Factor B on multiple comparison testing found that there was no significant difference between the groups. All groups for Factor B were within the "slightly dissatisfied" range (0 to -1). Again, the small sample size of the Administrative Support group plays a role in the resulting nonsignificant findings.

Interestingly, the Administrative Support group were less satisfied than the other two groups as to the accuracy of the output. However, there were nonsignificant differences between all groups found in Factor C.

TABLE 4.8B
SCHEFFE MULTIPLE COMPARISON TESTING;
NH CHARLESTON USER GROUPS

QUESTIONS/FACTORS	USER GROUPS COMPARISON		
	PHYSICIAN/ MEDICAL SUPPORT	PHYSICIAN/ ADMIN SUPPORT	MEDICAL SUPPORT/ ADMIN SUPPORT
4. USER'S UNDERSTANDING OF SYSTEM	S(1)	NS(2)	NS
9. ACCURACY OF OUTPUT	NS	S	S
12. TIME REQUIRED FOR NEW DEVELOPMENT	S	NS	NS
OVERALL SCORE	NS	NS	NS
B. CONTRACTOR SERVICES	NS	NS	NS
D. KNOWLEDGE AND INVOLVEMENT	S	NS	NS

NOTES:
(1) S = Significant difference in means
(2) NS = Nonsignificant; no difference in means

c. Naval Hospital Camp Lejeune

(1) Differences between User Groups. Table 4.9A shows the ANOVA testing results between user groups. Significant findings (at alpha = 0.05) are underlined. The Physician group sample size consisted of 22 participants; the Medical Support group consisted of 75 participants; and the Administrative Support group consisted of 24 participants. The *a posteriori* testing for normality via the NSCORES correlation demonstrates that the data has a normal distribution. Except for questions 6 and 9, the Hartley Fmax test revealed homogeneity of variance between groups. However, on subsequent testing using nonparametric procedures, resulted in finding the same values and patterns.

Although the Physician group's mean value for Factor B was within the "slightly dissatisfied" range (0 to -1), and the other two groups were within the "slightly satisfied" range of (0 to 1), there was no significant difference in means between the groups. There was no significant difference between the three groups concerning the information product output (Factor C). All three groups were within the "quite satisfied" range (1 to 2) for Factor C.

TABLE 4.9A
NH CAMP LEJEUNE USER GROUP ANOVA TESTING

QUESTIONS/FACTORS	USER GROUP MEANS (1)			F VALUE	P VALUE	NSCORES CORRELATION	HARTLEY FMAX(2)
	P	M	A				
1. RELATIONSHIP WITH MID STAFF	1.36	1.22	2.19	5.78	0.004	0.98	1.76
2. PROCESSING OF REQUESTS FOR CHANGE	-0.05	0.24	0.25	0.37	0.690	0.98	1.25
3. DEGREE OF TRAINING	0.05	0.52	0.50	0.75	0.475	0.99	1.07
4. USER'S UNDERSTANDING OF SYSTEM	-0.59	0.82	1.33	7.95	0.001	0.98	1.17
5. USER'S FEELING OF PARTICIPATION	-0.21	0.99	1.31	7.98	0.001	0.99	1.47
6. ATTITUDE OF MID STAFF	1.77	1.33	2.42	7.09	0.001	0.98	2.32
7. RELIABILITY OF OUTPUT	1.32	1.27	1.27	0.01	0.989	0.96	1.31
8. RELEVANCY OF OUTPUT	0.71	1.23	1.35	1.64	0.199	0.98	1.30
9. ACCURACY OF OUTPUT	1.50	1.33	1.44	0.19	0.828	0.98	2.85
10. PRECISION OF OUTPUT	0.86	0.79	1.08	0.45	0.637	0.97	1.54
11. COMMUNICATION WITH MID STAFF	1.34	1.03	2.17	6.59	0.002	0.98	2.07
12. TIME REQUIRED FOR NEW DEVELOPMENT	-0.52	0.34	0.13	2.63	0.076	0.99	1.50
13. COMPLETENESS OF OUTPUT	0.84	0.93	1.04	0.11	0.897	0.98	1.41
OVERALL SCORE	8.39	12.08	16.48	2.53	0.084	0.99	1.54
A. MID STAFF AND SERVICES	1.49	1.20	2.26	8.45	0.000	0.98	1.43
B. CONTRACT SERVICES	-0.28	0.29	0.19	1.64	0.199	0.99	1.13
C. INFORMATION OUTPUT	1.05	1.11	1.24	0.20	0.823	0.99	1.39
D. KNOWLEDGE AND INVOLVEMENT	-0.25	0.78	1.05	6.61	0.002	0.99	1.21

NOTES:
(1) P = Physicians; M = Medical Support; A = Administrative Support
(2) Hartley's $Fmax_{(3,39)}$ approximate critical value = 2.24 at alpha = 0.05

(2) Significant User Group Findings. Table 4.9B represents those items where the ANOVA testing in Table 4.9A revealed a significant difference in the means between the user groups. Scheffe multiple comparison testing was used to identify the individual differences user groups.

The Medical Support group was less satisfied when compared with the Administrative Support group for Factor A, and no significant difference with the Physician group. The Medical Support group and the Physician group for Factor A were within the "quite satisfied" range (1 to 2), whereas the Administrative Support group was within the "extremely satisfied" range (2 to 3). The Physician Support group was less satisfied for Factor D than the two other groups. The Physician Support group for Factor D were within the "slightly dissatisfied" range (0 to -1), whereas, the other two groups were essentially within the "slightly satisfied" range (0 to 1).

TABLE 4.9B
SCHEFFE MULTIPLE COMPARISON TESTING;
NH CAMP LEJEUNE USER GROUP

QUESTIONS/FACTORS	USER GROUPS COMPARISON		
	PHYSICIAN/ MEDICAL SUPPORT	PHYSICIAN/ ADMIN SUPPORT	MEDICAL SUPPORT/ ADMIN SUPPORT
1. RELATIONSHIP WITH MID STAFF	NS(1)	NS	S(2)
4. USER'S UNDERSTANDING OF SYSTEM	S	S	NS
5. USER'S FEELING OF PARTICIPATION	S	S	NS
6. ATTITUDES OF MID STAFF	NS	NS	S
11. COMMUNICATING WITH MID STAFF	NS	NS	S
A. MID STAFF AND SERVICES	S	NS	S
D. KNOWLEDGE AND INVOLVEMENT	S	S	NS

NOTES:
(1) NS = Nonsignificant; no difference in means
(2) S = Significant difference in means

d. Naval Hospital Jacksonville

(1) Differences between User Groups. Table 4.10A shows the ANOVA testing results between user groups. Significant findings (at alpha = 0.05) are underlined. The Physician Support group sample size consisted of 36 participants; the Medical Support group consisted of 61 participants; and the Administrative Support group consisted of 21 participants. The *a posteriori* testing for normality via the NSCORES correlation demonstrates that the data has a normal distribution. The Hartley Fmax test revealed homogeneity of variance between the user groups.

There was no significant difference between user group means for Factor C. All user groups were within the "slightly satisfied" range (0 to 1) for Factor C. Question 3 dealing with the degree of training was found initially to have significant differences in user group means. However, on subsequent testing as denoted in Table 4.10B, there was no significant difference. All user groups for question 3 were essentially within the "slightly dissatisfied" range (0 to -1).

TABLE 4.10A
NH JACKSONVILLE USER GROUP ANOVA TESTING

QUESTIONS/FACTORS	USER GROUP MEANS (1)			F VALUE	P VALUE	NSCORES CORRELATION	HARTLEY FMAX(2)
	P	M	A				
1. RELATIONSHIP WITH MID STAFF	0.29	0.94	0.93	3.70	0.028	0.99	1.44
2. PROCESSING OF REQUESTS FOR CHANGE	-1.58	-0.76	-0.36	5.18	0.007	0.99	2.19
3. DEGREE OF TRAINING	-1.08	-0.30	-0.21	3.29	0.041	0.99	1.58
4. USER'S UNDERSTANDING OF SYSTEM	-0.14	0.77	1.12	5.80	0.004	0.98	1.18
5. USER'S FEELING OF PARTICIPATION	-0.44	0.53	0.19	4.81	0.010	0.99	2.00
6. ATTITUDE OF MID STAFF	0.46	0.85	0.88	1.34	0.265	0.98	1.89
7. RELIABILITY OF OUTPUT	0.99	0.81	0.93	0.17	0.846	0.97	1.12
8. RELEVANCY OF OUTPUT	0.54	0.76	0.64	0.26	0.772	0.98	1.07
9. ACCURACY OF OUTPUT	1.17	0.91	0.64	1.02	0.364	0.97	1.51
10. PRECISION OF OUTPUT	1.04	0.79	0.50	1.34	0.266	0.99	1.81
11. COMMUNICATION WITH MID STAFF	0.13	0.68	0.71	2.61	0.078	0.99	2.01
12. TIME REQUIRED FOR NEW DEVELOPMENT	-1.42	-0.36	-0.07	6.08	0.003	0.99	1.40
13. COMPLETENESS OF OUTPUT	0.17	0.67	0.67	1.15	0.319	0.97	1.64
OVERALL SCORE	0.11	6.30	6.57	3.19	0.045	0.99	2.22
A. MID STAFF AND SERVICES	0.29	0.83	0.84	2.96	0.056	0.98	1.74
B. CONTRACT SERVICES	-1.50	-0.56	-0.21	7.27	0.001	0.99	2.09
C. INFORMATION OUTPUT	0.78	0.79	0.68	0.07	0.931	0.98	1.39
D. KNOWLEDGE AND INVOLVEMENT	-0.56	0.33	0.37	6.50	0.002	0.99	2.09

NOTES:
(1) P = Physicians; M = Medical Support; A = Administrative Support
(2) Hartley's $Fmax_{(3,30)}$ approximate critical value = 2.25 at alpha = 0.05

(2) Significant User Group Findings. Table 4.10B represents those items where the ANOVA testing in Table 4.10A revealed a significant difference in the means between the user groups. Scheffe multiple comparison testing was used to identify the individual differences between user groups.

The Physician Support group was significantly less satisfied for Factor B than the other two user groups. The Medical Support group and the Administrative Support group for Factor B were within the "slightly dissatisfied" range (0 to -1) whereas, the Physician group was within the "quite dissatisfied" range (-1 to -2). The Physician group was significantly less satisfied for Factor D than the two other user groups. The Medical Support group and the Administrative Support group for Factor D were within the "slightly satisfied" range (0 to 1) whereas, the Physician group was within the "slightly dissatisfied" range (0 to -1).

TABLE 4.10B
SCHEFFE MULTIPLE COMPARISON TESTING;
NH JACKSONVILLE USER GROUP

QUESTIONS/FACTORS	USER GROUPS COMPARISON		
	PHYSICIAN/ MEDICAL SUPPORT	PHYSICIAN/ ADMIN SUPPORT	MEDICAL SUPPORT/ ADMIN SUPPORT
1. RELATIONSHIP WITH MID STAFF	S(1)	NS(2)	NS
2. PROCESSING OF REQUESTS FOR CHANGES	S	S	NS
3. DEGREE OF TRAINING PROVIDED	NS	NS	NS
4. USER'S UNDERSTANDING OF SYSTEM	S	S	NS
5. USER'S FEELING OF PARTICIPATION	S	NS	NS
12. TIME REQUIRED FOR NEW DEVELOPMENT	S	S	NS
OVERALL SCORE	S	S	NS
B. CONTRACTOR SERVICES	S	S	NS
D. KNOWLEDGE AND INVOLVEMENT	S	S	NS

NOTES:
(1) S = Significant difference in means
(2) NS = Nonsignificant; no difference in means

V. MULTIDIMENSIONAL SCALING DESCRIPTIVE FINDINGS

A. INTRODUCTION

This chapter discusses the results of employing multidimensional scaling to raw data collected from Naval Hospitals Charleston, Camp Lejeune and Jacksonville. In the sections that follow, we discuss the goodness of fit of the data to the solution, the stimulus coordinates and finally the spatial map for those coordinates.

B. GOODNESS OF FIT

In Chapter IV, we discussed the goodness of fit and its relationship to determining the dimensionality of data once it is processed through ALSCAL. While Kruskal and Wish (1978) say this measure is a "very important consideration in determining how many dimensions are appropriate, they also suggest that the STRESS value "has received the most systematic statistical study". The results of running the raw data for the hospitals and the combination for all hospitals are presented below. Table 5.1 shows the STRESS and RSQ values for each hospital and the combined hospitals.

TABLE 5.1
GOODNESS OF FIT DATA

HOSPITAL	S-STRESS	RSQ
Charleston	0.101	0.956
Camp Lejeune	0.107	0.948
Jacksonville	0.047	0.992
All Hospitals	0.066	0.983

In order to derive the S-STRESS value, ALSCAL goes for seven iterations before reaching a value which is less than 0.001 (the S-STRESS Improvement) (SPSS, 1988). With each iteration the value for S-STRESS decreases. Likewise, the value of the squared correlation coefficient (RSQ) is also changing. However, RSQ indicates the amount of error. The smallness of the difference between the two values shows how good the fit is between the data and the solution. NH Charleston has a S-STRESS of 0.101 and RSQ of 0.956, indicating the fit is fairly good but not perfect.

The fit of data to solution for NH Camp Lejeune is slightly better. Its S-STRESS value is 0.107 and RSQ is 0.948. Camp Lejeune stops the iterations after five times when it reaches an improvement less than 0.001. Results for NH Jacksonville were reached after only four iterations. The S-STRESS value is 0.047 and RSQ of 0.992. This value is almost perfect indicating the fit at Jacksonville is very good. Finally, the findings for Combined Hospitals data shows a S-STRESS of 0.066 and RSQ of 0.983. These measures were reached after six iterations.

C. STIMULUS COORDINATES AND SPATIAL MAP

Before a spatial map is produced, ALSCAL generates a set of coordinates for each variable based on the number of dimensions. Theses coordinates are then plotted on the graph to show the relative similarity of the variables.

1. Naval Hospital Charleston (CHAS)

Table 5.2 shows the coordinates (dimensions) for NH Charleston. A Stimulus Number, Stimulus Name and Plot Symbol are assigned by ALSCAL b sed on the variable name inputs to the procedure. The configuration that results is the coordinates and the spatial map for the plot symbols.

TABLE 5.2
STIMULUS COORDINATES (CHAS)

			DIMENSION	
STIMULUS NUMBER	STIMULUS NAME	PLOT SYMBOL	1	2
1	RELMID	1	1.5668	0.1725
2	CHGSYS	2	-2.7662	-0.3856
3	TRNG	3	-0.4844	-1.2619
4	UNDERSTD	4	0.5372	-1.4263
5	PARTIC	5	0.5659	0.5137
6	MIDATT	6	1.6293	0.2655
7	RELVINFO	7	-0.2509	0.4950
8	RELVINFO	8	0.2863	0.4021
9	ACCINFO	9	0.5371	0.5299
10	PRECINFO	A	-0.4610	-0.2756
11	MIDCOMM	B	1.2998	-0.2932
12	TIMEDEV	C	-1.9174	1.0203
13	COMPLETE	D	-0.5424	0.2435

Each coordinate corresponds to a plot on graph. Figure 5.1 depicts the derived stimulus coordinates. Starting in the upper right-hand corner and moving counterclockwise on graph, the quadrants are labeled QUAD I, QUAD II, QUAD III,

and QUAD IV respectively. Plot symbols 1, 6, 8, and 9 are located in QUAD I. Plot symbols 7, C, and D are located in QUAD II. The remainder of the variables are located in QUAD III (3 and A) and IV (4 and B). Plot symbol 2 does not plot on the graph because it is outside of the coordinate axes. In statistical jargon it would be called an outlier. The groupings for the quadrants are 1) User Assessment of Information Characteristics (QUAD I), 2) System Changes/ Contractor Services (QUAD II), 3) User Involvement (QUAD III) and 4) User Relations with MID (QUAD IV).

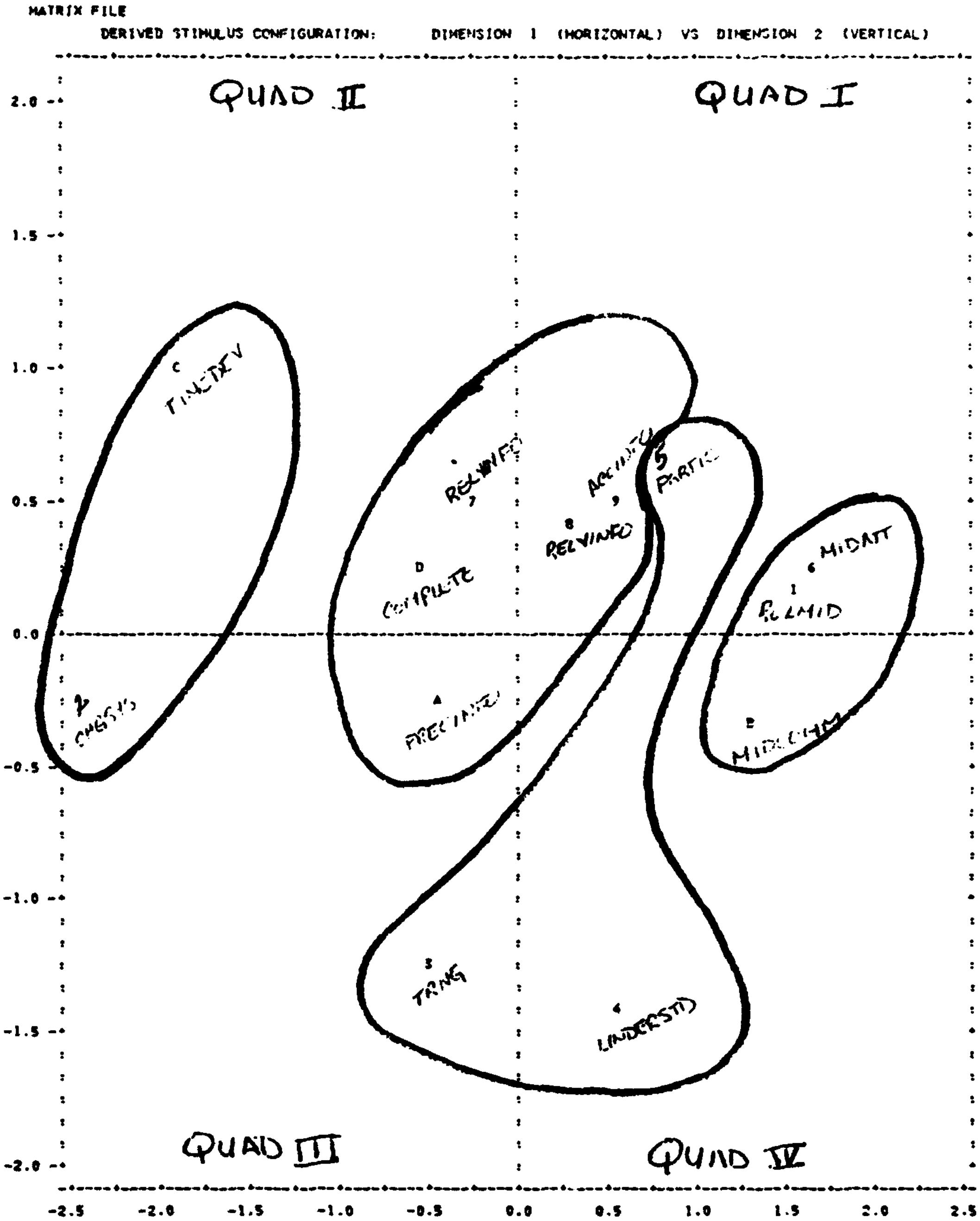

Figure 5.1. NH Charleston Spatial Map

2. Naval Hospital Camp Lejeune (JUNE)

Data for NH Camp Lejeune was processed by ALSCAL and produced the results found in Table 5.3. Stimulus Coordinates along with the number, name and plot symbol are shown in Table 5.3 The information for each hospital is the same in the table except for the coordinates.

TABLE 5.3
STIMULUS COORDINATES (JUNE)

STIMULUS NUMBER	STIMULUS NAME	PLOT SYMBOL	DIMENSION 1	DIMENSION 2
1	RELMID	1	1.1892	-0.4106
2	CHGSYS	2	-1.4538	1.3415
3	TRNG	3	-1.7379	-0.5336
4	UNDERSTD	4	-1.5665	-1.6219
5	PARTIC	5	-0.4333	-0.5878
6	MIDATT	6	1.6340	-0.4317
7	RELYINFO	7	0.7576	0.4019
8	RELVINFO	8	0.3418	0.1675
9	ACCINFO	9	1.2026	0.0903
10	PRECINFO	A	0.2952	0.8516
11	MIDCOMM	B	1.3466	-0.2681
12	TIMEDEV	C	-1.7667	0.6659
13	COMPLETE	D	0.1909	0.3552

The configuration that results from the coordinates in Table 5.3 is Figure 5.2. The spatial map for NH Camp Lejeune shows the groupings for the data. In QUAD I, plot symbols 7, 8, 9, A, and D are found. Plot symbols 2 and C are located in QUAD II. Plot symbols 3, 4, and 5 are found in QUAD III and QUAD IV holds plot symbols 1, 6, and B. The general groupings for each quadrant are the same as listed in Section C.1.

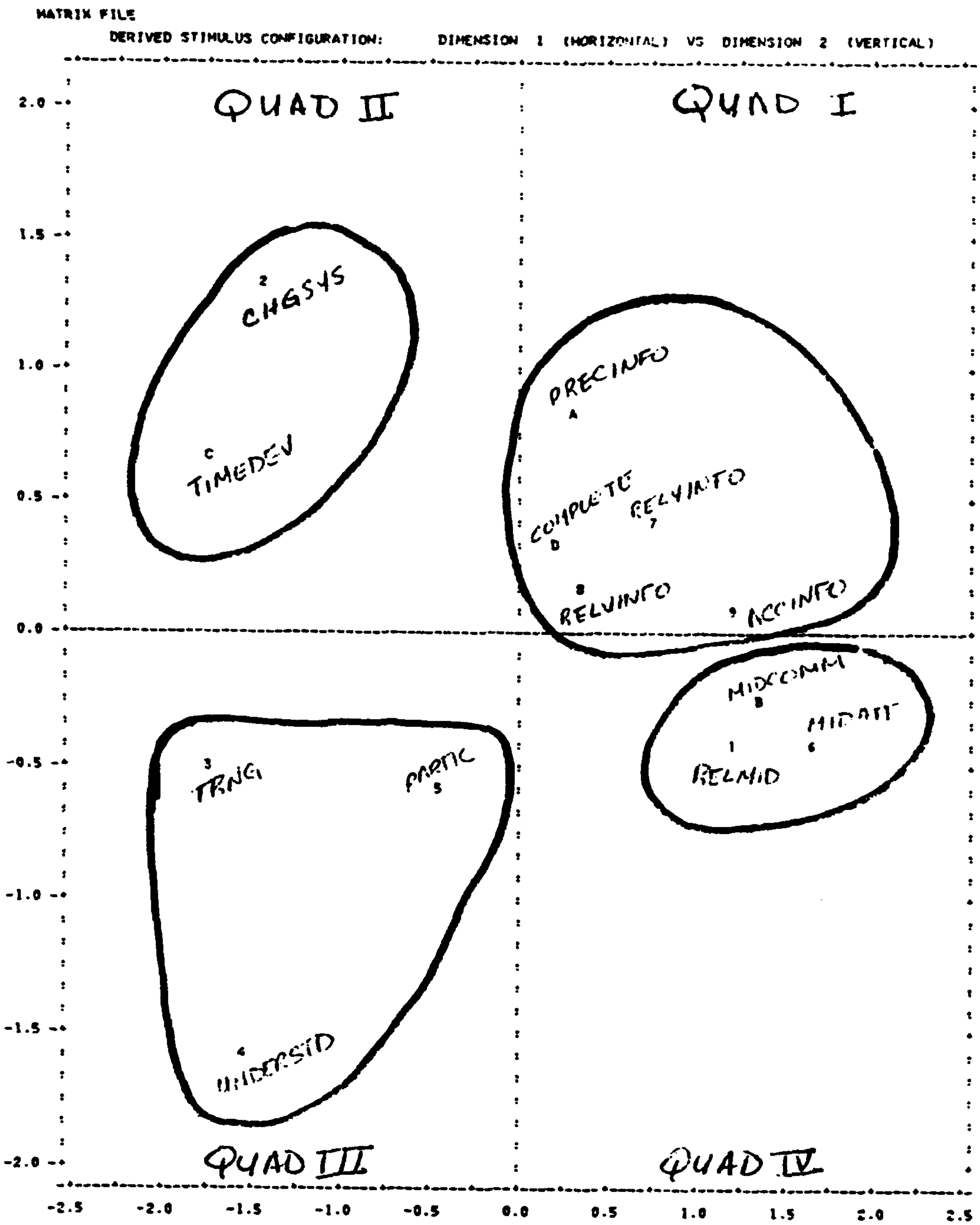

Figure 5.2. NH Camp Lejeune Spatial Map

3. Naval Hospital Jacksonville (JAX)

Table 5.4 shows the coordinate data for NH Jacksonville. Coordinate pairs for each of the 13 variables

used in the short form questionnaire are displayed. These coordinates are shown in Figure 5.3 plotted on the graph to depict the relationship of the data in a spatial map.

TABLE 5.4
STIMULUS COORDINATES (JAX)

STIMULUS NUMBER	STIMULUS NAME	PLOT SYMBOL	DIMENSION 1	DIMENSION 2
1	RELMID	1	1.1323	-0.0563
2	CHGSYS	2	-2.7150	0.2630
3	TRNG	3	-1.7463	-0.7352
4	UNDERSTD	4	0.3343	-1.3727
5	PARTIC	5	-0.3103	-0.6236
6	MIDATT	6	0.7192	-0.5080
7	RELVINFO	7	1.0480	0.3674
8	RELVINFO	8	0.7555	0.5188
9	ACCINFO	9	1.1238	0.6337
10	PRECINFO	A	0.8900	-0.0408
11	MIDCCMM	B	0.3311	-0.2883
12	TIMEDEV	C	-1.9616	0.9299
13	COMPLETE	D	0.3990	0.9120

The configuration that results from Table 5.4 is shown as Figure 5.3. In Figure 5.3, the plot symbols are displayed in the quadrant corresponding to their coordinates. In QUAD I are 7, 8, 9, A, and D. In QUAD II is C. Plot symbols 3 and 5 are in QUAD III and plot symbols 1, 6, and B are found in QUAD IV.

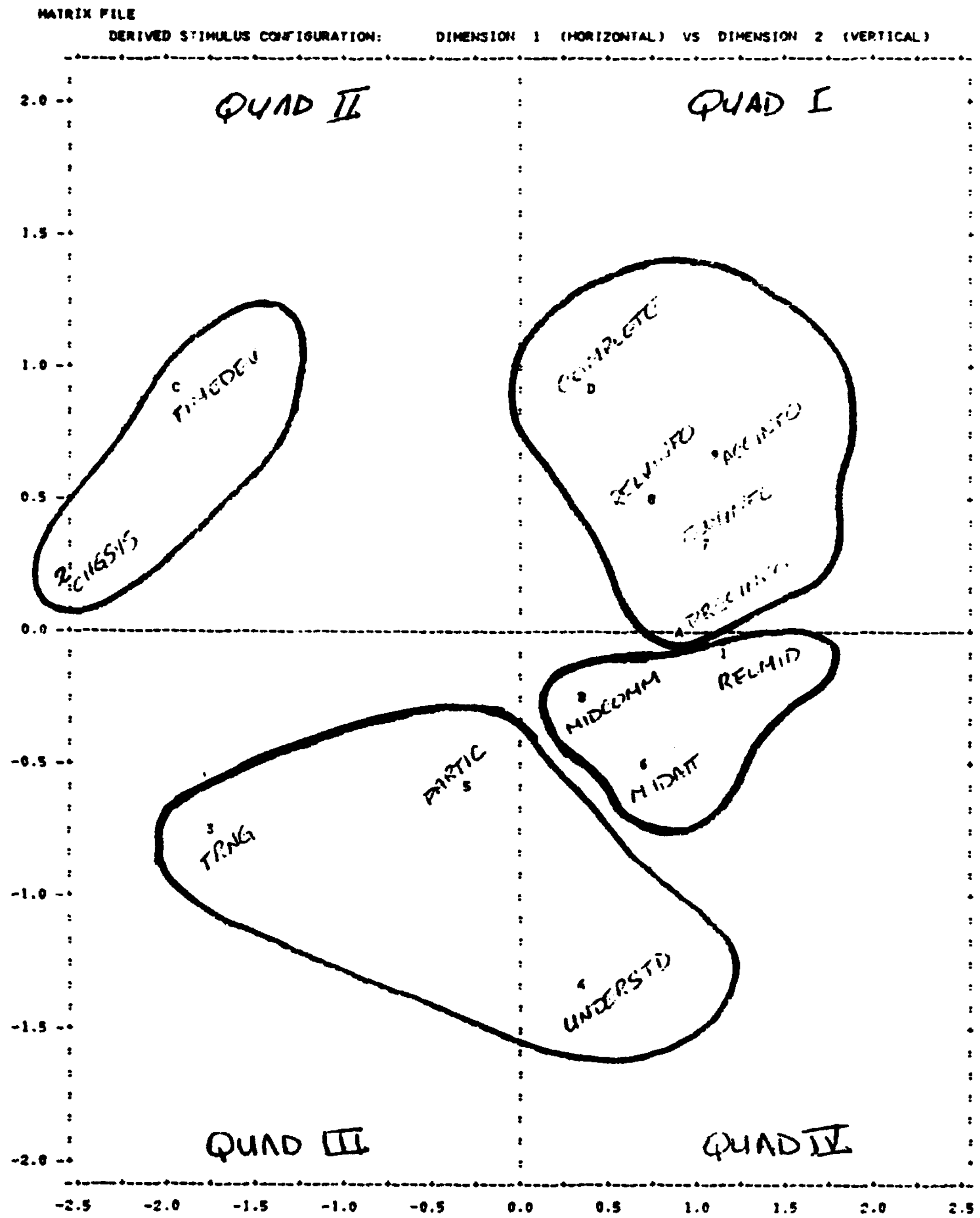

Figure 5.3. NH Jacksonville Spatial Map

4. Combined Hospital Data (ALLHOSP)

The coordinates for the Combined Hospital Data is found in Table 5.5. Along with the stimulus number, name and

plot symbol are the dimensions for graphing the stimulus. This data is significant because it shows what happens with a very large samples size.

TABLE 5.5
STIMULUS COORDINATES (ALLHOSP)

STIMULUS NUMBER	STIMULUS NAME	PLOT SYMBOL	DIMENSION 1	DIMENSION 2
1	RELMID	1	1.3036	0.0052
2	CHGSYS	2	-2.6290	0.4609
3	TRNG	3	-1.2788	-1.2291
4	UNDERSTD	4	0.0508	-1.7153
5	PARTIC	5	-0.9993	-0.4483
6	MIDATT	6	1.4548	-0.1206
7	RELYINFO	7	0.5276	0.5917
8	RELVINFO	8	0.5015	0.4496
9	ACCINFO	9	1.0242	0.5179
10	PRECINFO	A	0.3555	0.3794
11	MIDCOMM	B	0.9382	-0.2649
12	TIMEDEV	C	-2.0431	0.7139
13	COMPLETE	D	-0.1060	0.6495

In Figure 5.4, the coordinates are plotted in the coordinate plane for each variable. In QUAD I, plot symbols 7, 8, 9, and A are found. Plot symbols of C and D are displayed in QUAD II. In QUAD III are plot symbols 3 and 5. Plots for 1, 6, and B are located in QUAD IV.

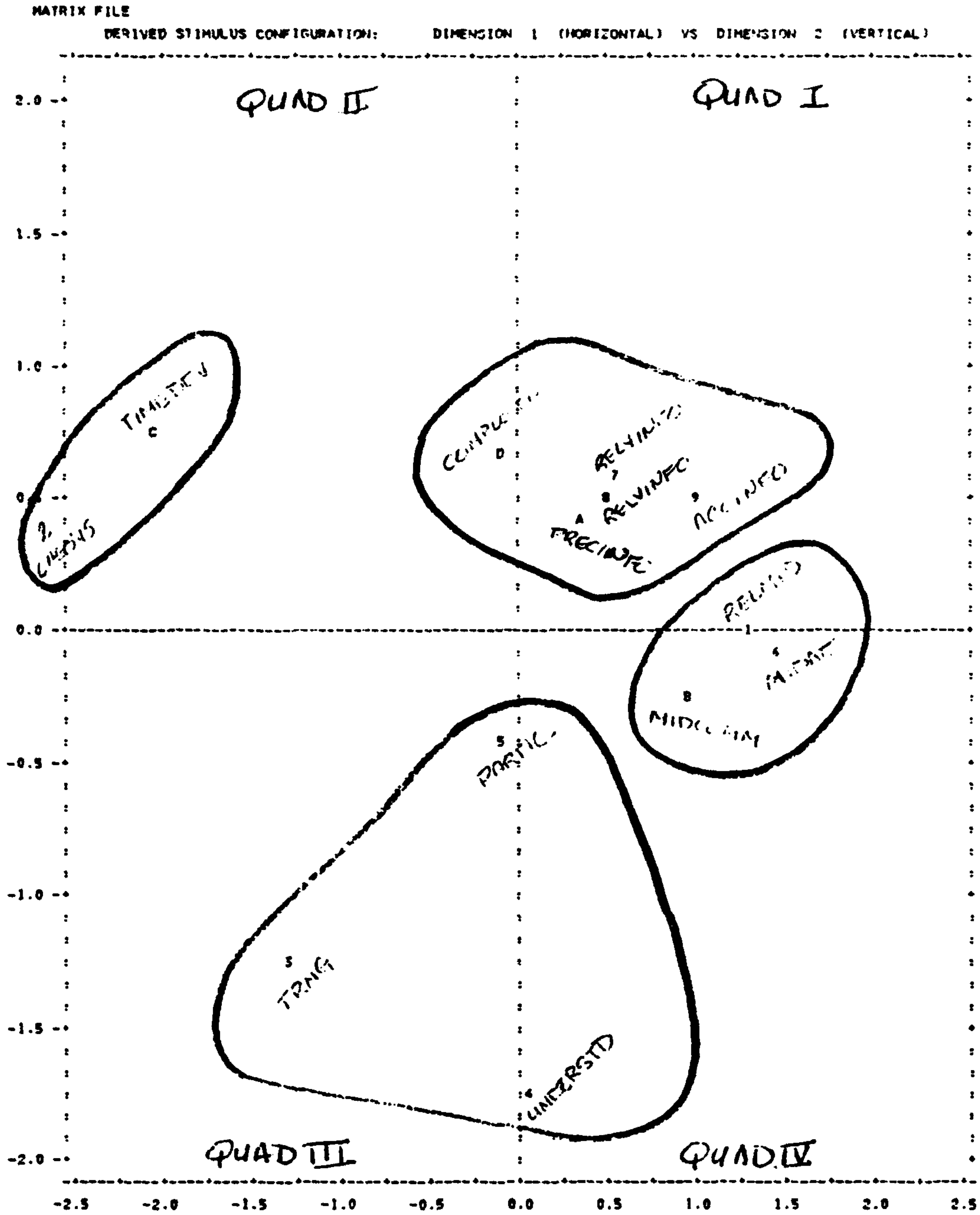

Figure 5.4. ALLHOSP Spatial Map

VI. ANALYSIS OF FINDINGS

A. INTRODUCTION

This chapter will cover analysis of the multidimensional scaling findings only. One section however, will cover comparative aspects of the studies.

B. GOODNESS OF FIT

Multidimensional scaling was used to determine the relationships among 13 variables and to identify the smallest number of underlying dimensions which would adequately represent those 13 variables (Harris, 1977). Interpreting the pattern or structure, which is often hidden in a proximity matrix, representing in a spatial map is the virtue of MDS. Consequently, the fewer dimensions used, the better.

The key step in assessing the fit is determining the labels for the axes in a spatial map. The group names used in Chapter V are useful in naming the axes. In QUAD I (User Assessment of Information Characteristics), notice that the coordinates are positive on the vertical and the horizontal axes for User Assessment. In QUAD II (System Changes/Contractor Services), the coordinates are negative on the horizontal axis and positive on the vertical axis. There is a negative horizontal and vertical axis in QUAD III (User Involvement). In QUAD IV (User Relations with MID), the

coordinates are positive on the horizontal axis and negative on the vertical axis.

C. LABELING THE AXES

In Chapter II, we discussed cost benefit analysis as it relates to UIS. Cost benefit analysis is an ever present management issue and is one that is sometimes difficult to accomplish because of the intangibles associated with benefit. We have labeled the vertical axis as COST and the horizontal axis as BENEFIT.

In general, information technology tends to be costly. Both hardware and software cost are on the increase. Additionally, within DoD, we find this cost coupled with almost double the regulations. Consequently, the hassle of acquiring an information system is a cost. There are cost involved in building and maintaining relationships with vendors and MIS staff. Particularly in government when a contractor can change from one phase of a project to the next phase. Time spent managing the systems, learning the system, using the system is also a cost. We find that as our workload increases because of the availability of information systems we have less time to do our job for the same reason. Finally, opportunity costs are ever present. These cost elements all play a role in UIS. They have positive and negative affects on the users of information systems.

Benefits of information systems from the user's perspective takes on as many faces as does cost. The main benefit is the amount of information we receive as a result of information systems. There is a benefit to learning to use information system. Information systems are also used as learning tools and teaching aids. Our jobs are made easier because of information systems and, while they may be time consuming, they allow us to make better decisions with information at our fingertips.

D. COST/BENEFIT AND HOSPITAL ANALYSIS

By adding the labels of COST and BENEFIT to the axis, we can better interpret what is meant when a variable falls in a particular quadrant. They now can depict characteristics associated with costs and benefit. Additionally, this enhances our understanding of the relationships among the variables as they cluster in a specific quadrant.

1. Naval Hospital Charleston

Figure 6.1 is the same as Figure 5.1 with the axes labels added. At each end of the vertical axis are the labels HIGH COST and LOW COST. At each end of the horizontal axis are the labels HIGH BENEFIT and LOW BENEFIT.

Quadrant one now represents characteristics that have a high benefit and high cost. This is akin to high risk and high gain. The variables RELMID, MIDATT, RELVINFO, and ACCINFO in QUAD I have a high cost and a high benefit

associated with them. However, RELMID and MIDATT seem as if they should fall in QUAD IV. In analyzing all data, note that the Charleston data were collected by different experimenter at a different time from the other two hospitals. Therefore, the results of NH Charleston, has more variance than the others two and the ALLHOSP data. It would stand to reason that we incur greater costs to get relevant and accurate information. On that same note, the respondents get a higher return in the accuracy of information.

In QUAD II, TIMEDEV and COMPLETE are consistent with high cost and low benefits. However, RELYINFOR seems to be misplaced in this quadrant. Usually if we pay more to get more reliable information the benefits of the data is better. In this case the cost was countered with possible error rates which were seen as a lower benefit. Low benefits were associated with low costs for training of personnel. In QUAD III, TRNG and PRECINFO are clustered together. User's understanding of the system (UNDERSTD) is clustered in QUAD IV with MIDCOMM.

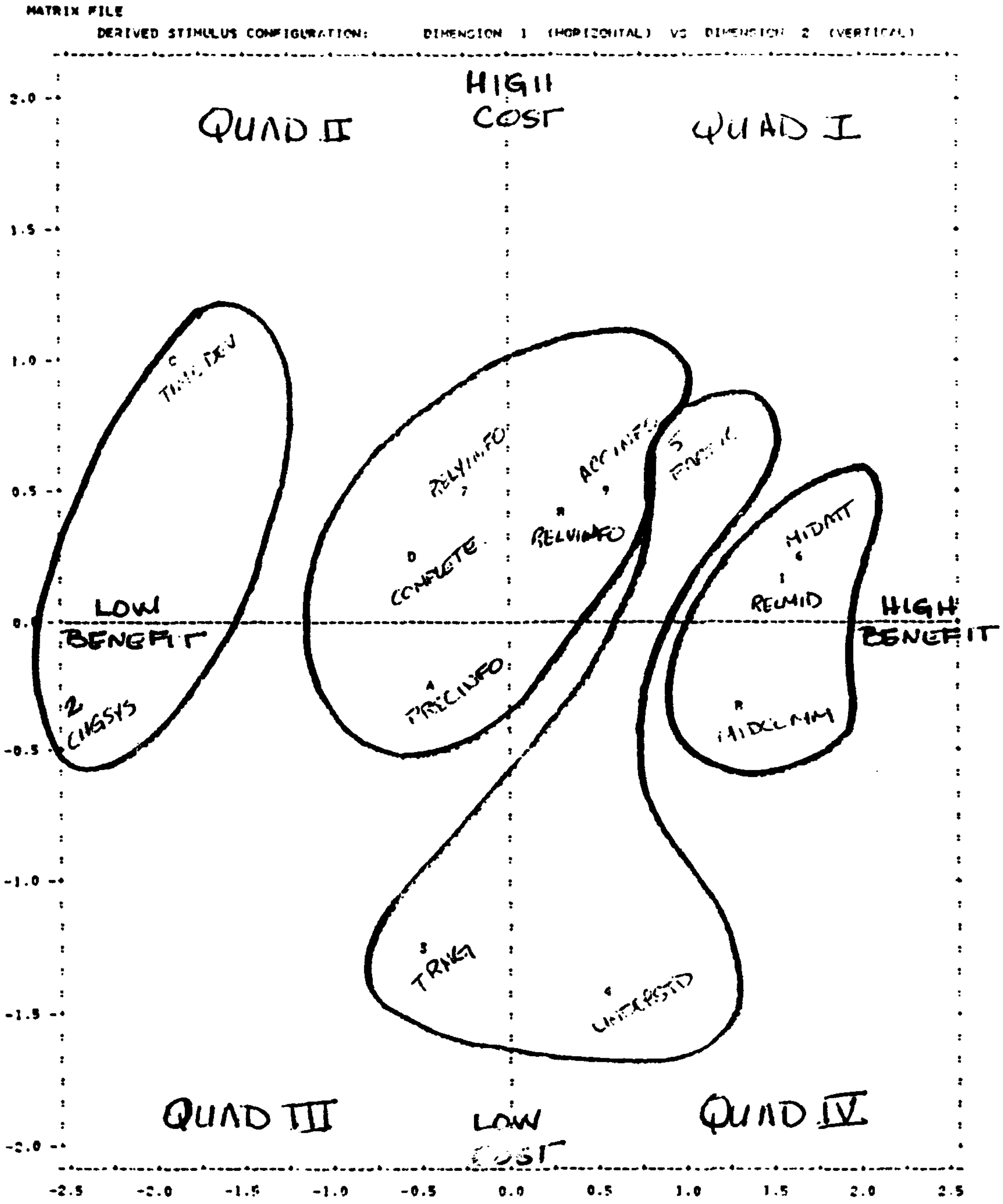

Figure 6.1. NH Charleston with Labels

Not surprising, NH Charleston shows the most variance of the three hospitals.

2. Naval Hospital Camp Lejeune

Figure 6.2 is the same as Figure 5.2 with the axes labels added. The variables RELYINFO, RELVINFO, ACCINFO, PRECINFO, and COMPLETE fall in QUAD I. High cost and high benefit characterizes this quadrant. Information systems managers must spend tremendous cost in order to gain the equally high benefit of reliable, relevant, accurate, precise, and complete information as outputs from the system.

In QUAD II, changes to the system whether by the contractor or in-house staff tend to be costly although the benefit may not be as high as the cost. Variables in QUAD III are TRNG, UNDERSTD, and PARTIC, indicating that both cost and benefit in this area of user involvement are relatively low. In QUAD IV, the relationship of users with MID staff is reflected by the variables located here. Areas of communication, attitude, and basic relationships with the MID staff can often be low cost if they are in-house. The benefits in this area tend to be quite high.

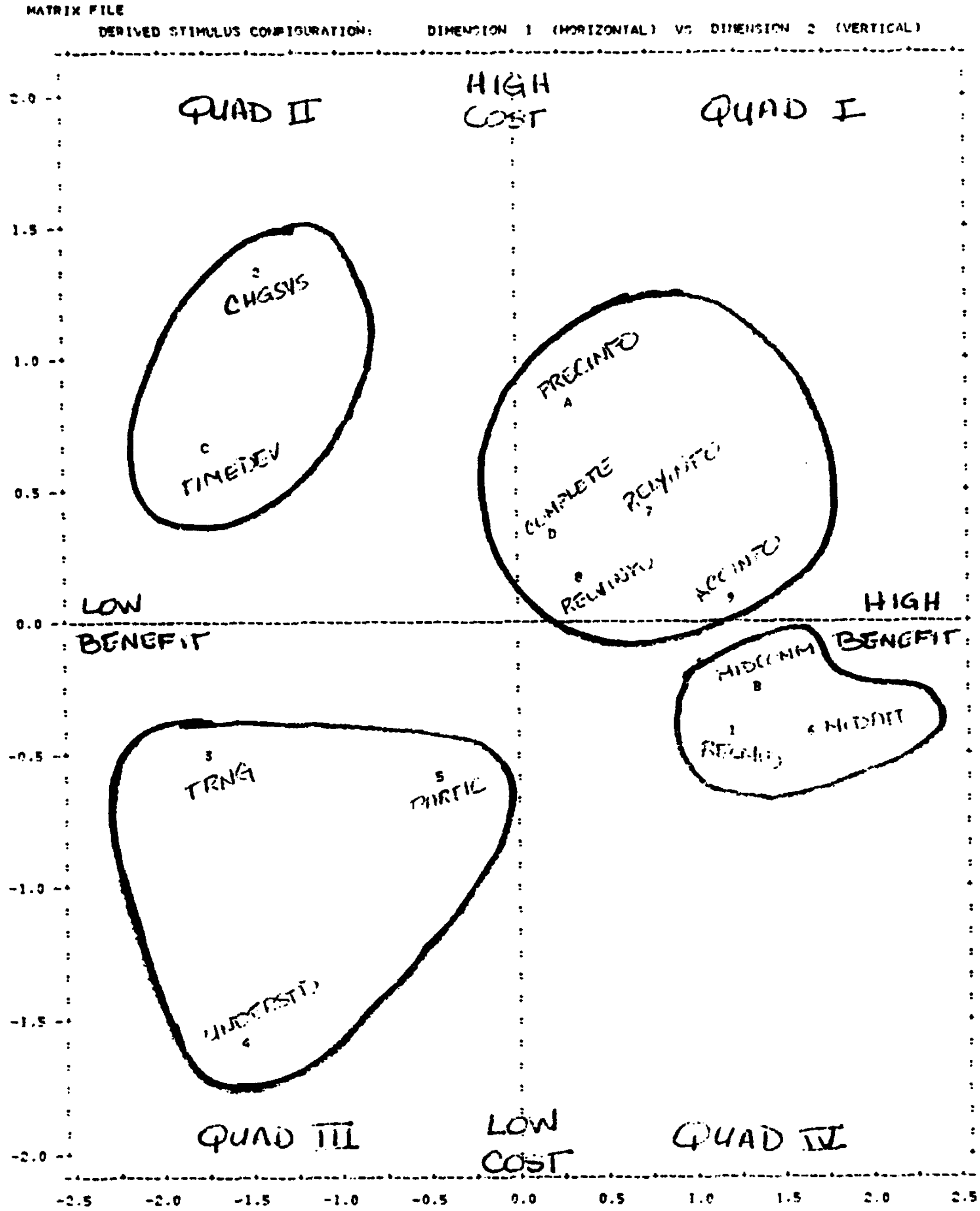

Figure 6.2. NH Camp Lejeune with Labels

3. Naval Hospital Jacksonville

Figure 6.3 is the same as Figure 5.3 with the axes labeled. The breakout of the variables by quadrant is similar

to NH Camp Lejeune. The only difference in this graph is between quadrant three and four. User's understanding of the system has moved to QUAD IV where the characteristics are high benefit and low cost. An explanation of this behavior would be that at Jacksonville personnel feel that a higher benefit could be gained from incurring greater costs to help users understand the system. In QUAD I, precision of output falls on the border between user assessment of information characteristics and user relations with MID staff. This would indicate a tug of war between the user's perception of the system and their relationship with MID.

4. Combined Hospital Data

Figure 6.4 is the same as Figure 5.4 with the axes labels added to it. In general, Figure 6.4 was similar to NH Camp Lejeune and Jacksonville. Charleston Naval Hospital varied from this. In Figure 6.4, variables that fall in QUAD I are those related to user assessment: RELYINFO, RELVINFO, ACCINFO, and PRECINFO. On the horizontal axis is RELMID which tends to indicate overall for the hospitals cost of having a relationship with MID is not a factor but benefits in this area are still high. In the area of user involvement (QUAD III) user's understanding of the system has shifted to QUAD IV. This is in part due to the variance in Charleston data. User's feel that the cost and benefit associated with understanding the system is fairly low.

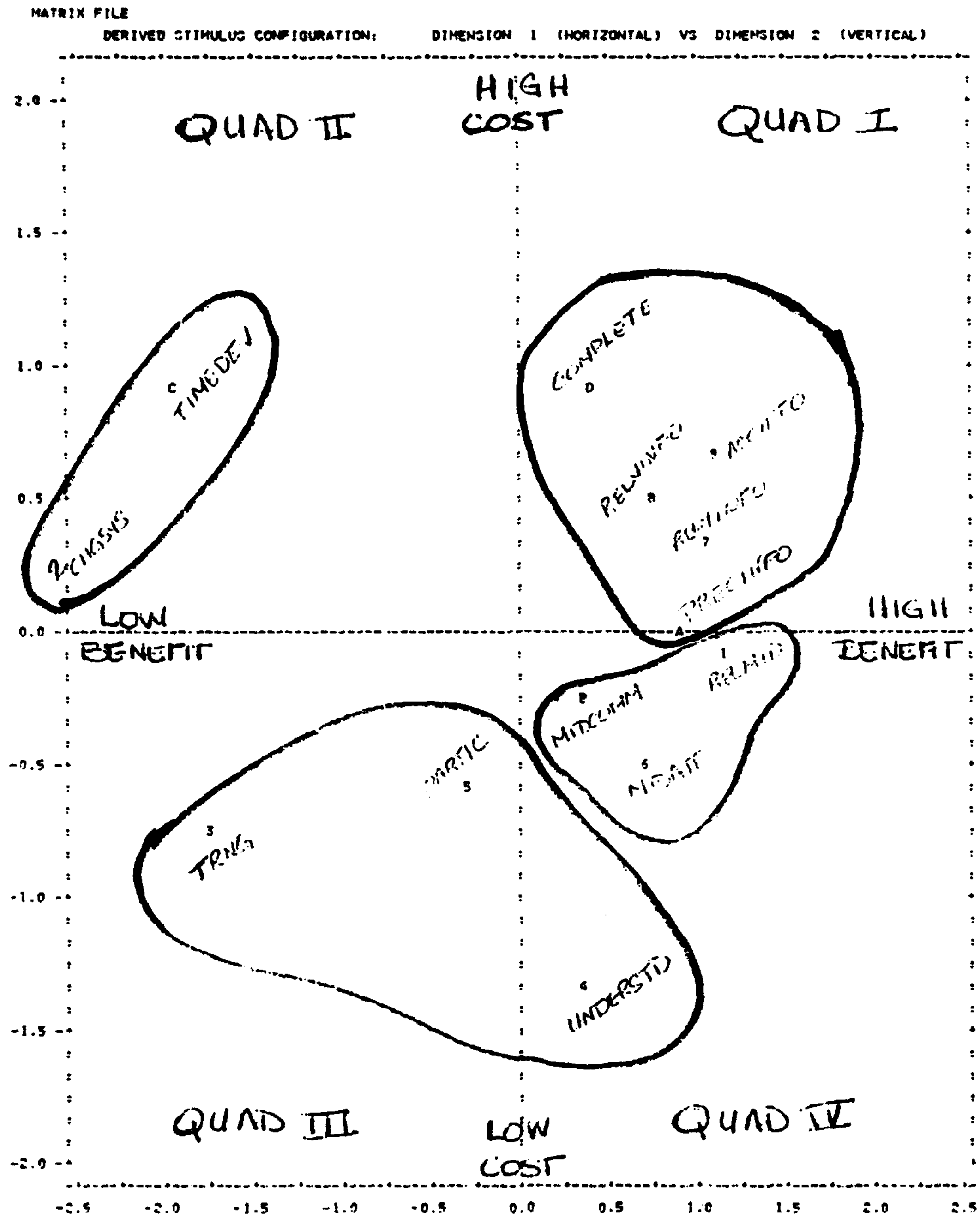

Figure 6.3. NH Jacksonville with labels

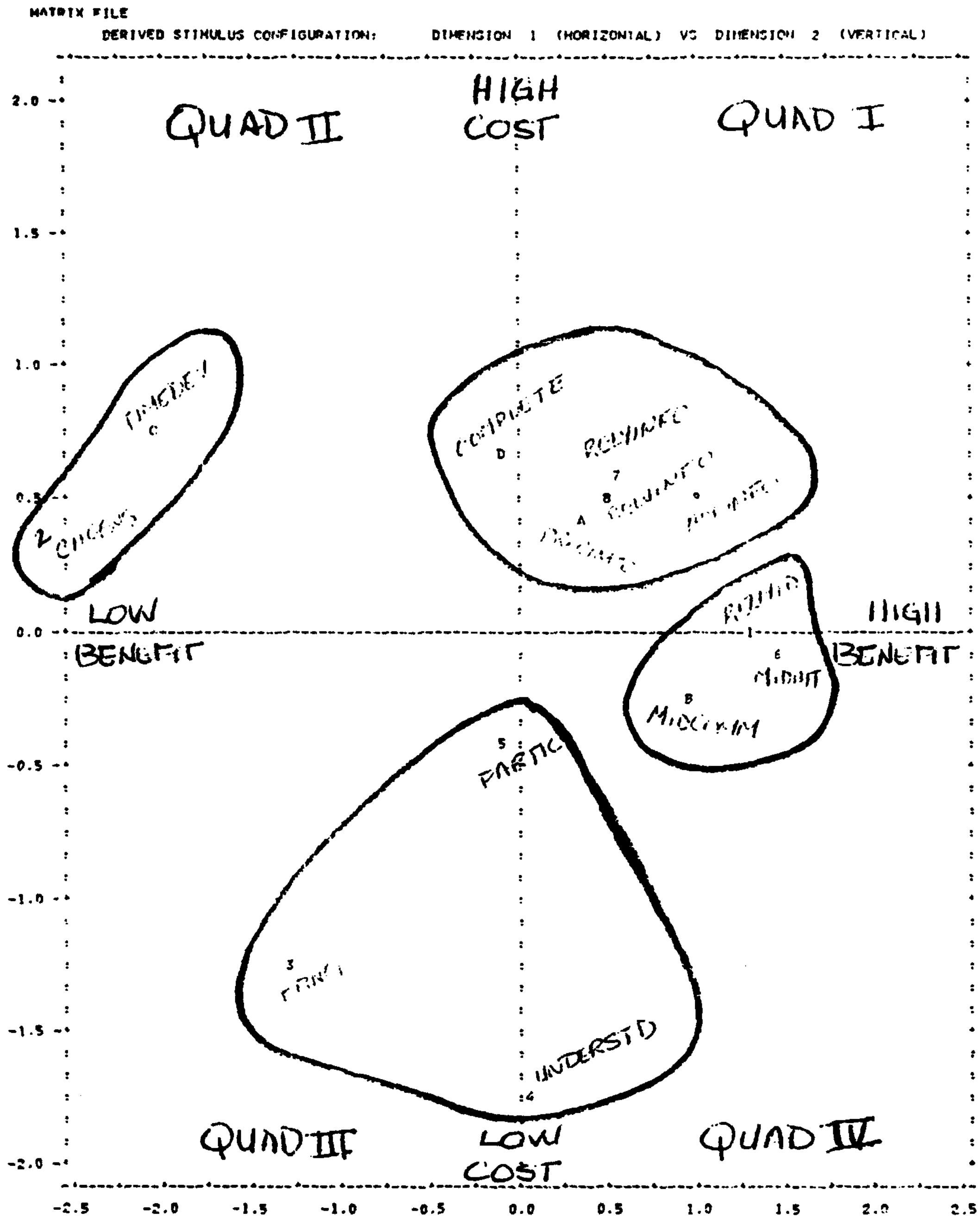

Figure 6.4. Combined Hospitals with labels

E. COMPARISON OF RESULTS

Factor analysis and multidimensional scaling are both dimensional analysis techniques. In general, the differences between factor analysis and multidimensional scaling lies in how data is displayed and processed. Schiffmann et al. (1981)

describes the differences in terms of how data is represented. In MDS data are represented as distance between variables, whereas in factor analysis, the variables are based on the angles between vectors. The advantage of MDS over factor analysis comes in the interpretation. Factor analysis assumes linear relationships between variables, while MDS does not. The result is fewer dimensions with MDS than with factor analysis.

1. Differences in Factor Analysis Results

Lockhart (1992) suggested that user satisfaction by factor differs depending on the user groups (Physician, Medical Support, Administrative Support). His analysis shows increased user satisfaction with increased relationship with MID. On the opposite side is increased dissatisfaction with Contractor service. In the areas of Information Product Outputs, users were satisfied with the outputs with no significant variance among the user groups. Factor D showed the user groups to satisfied for both Administrative and Medical Support. However, the physicians were dissatisfied in this area.

The results of multidimensional scaling are slightly different from those of Lockhart (1992). One reason for this is that the data in his study did not include user demographics. Thus this analysis is more general in terms of the variables rather than the user groups. Additionally, MDS

spatial maps make it easier than factor analysis to grasp where variables cluster together relative to the axes.

VII. CONCLUSIONS

The objective of this study was to determine if multidimensional scaling revealed more about user perception of satisfaction with information systems than did factor analysis. The answer is yes. Multidimensional scaling revealed meaning in the user satisfaction data that was not apparent in factor analysis. Moreover, it does it graphically.

There was no hint of the cost-benefit dimensions in the Hurd(1991) and Lockhart (1992) factor analyses. Their findings were at the level of the obvious labelling of factor loadings. This study probed deeper into their data to reveal meanings otherwise hidden. While the end results were not <u>substantially</u> different from those using factor analysis, what we did determine is that MDS sheds different light on the same data.

APPENDIX A.

Part A: General Information

1. Hospital Department: (Check one)
____ General Administration
____ Nursing Administration
____ Dietary
____ Emergency
____ Laboratory
____ Outpatient Clinic
____ Outpatient Nursing
____ Pharmacy
____ Radiology
____ Other (Specify):____________________________

2. Job Description: (Check one)
____ Clerk
____ Corpsman (0000)
____ Technician
____ Nurse
____ Pharmacist
____ Physician
____ Physician Assistant
____ Other (Specify):____________________________

3. Highest Level of Education: (Check one)
____ High School Graduate
____ Some College
____ Bachelor's Degree
____ Some Graduate Work
____ Master's Degree
____ Doctoral Degree
____ Medical Degree
____ Other (Specify):____________________________

4. Age: ____ years

5. Gender: ____ Male ____ Female

6. Length of time (in months) you have used CHCS: ____

7. Have you used other computer systems before __ No _ If your answer was Yes, was it a health care information system? ____ Yes ____ No

Part B: The Questionnaire

This section of the survey conveys your own personal feelings concerning the use of the Composite Health Care system at Naval Hospital, (LOCATION). Please do not attempt to analyze the questions. Remember, there are no right or wrong answers.

Please follow these instructions:

a. Check each scale in the position that describes your evaluation of the factor being described.

b. Check each scale, do not omit any.

c. Check only one position for each scale.

d. Check in the space, not between spaces. THIS, NOT THIS
:__X__: ___X___:

e. Work rapidly. Rely on your first impressions.

The scale positions are defined as follows:

adjective x:____:____:____:____;____:____:____:adjective Y
(1) (2) (3) (4) (5) (6) (7)

(I) extremely X(5) slightly Y
(2) quite X (6) quite Y
(3) slightly X(7) extremely Y
(4) neither X or Y; equally X or Y; does not apply

ANSWERS BASED ON YOUR OWN FEELINGS

1. Relationship with the Management Information Department (MID) staff

dissonant :____:____:____:____:____:____:____: harmonious

bad :____:____:____:____:____:____:____: good

2. Processing of requests for changes to existing systems

fast :____:____:____:____:____:____:____: slow

untimely :____:____:____:____:____:____:____: timely

3. Degree of training provided to users

complete :____:____:____:____:____:____:____:incomplete

low :____:____:____:____:____:____: high

4. Your understanding of systems

insufficient :____:____:____:____:____:____: sufficient

complete :____:____:____:____:____:____: incomplete

5. Your feeling of participation

positive :____:____:____:____:____:____: negative

insufficient :____:____:____:____:____:____: sufficient

6. Attitude of the Management Information Department staff

cooperative :____:____:____:____:____:____: belligerent

negative :____:____:____:____:____:____: positive

7. Reliability of output information

high :____:____:____:____:____:____: low

superior :____:____:____:____:____:____: inferior

8. Relevancy of output information to intended function (degree of what user wants or requires and what is provided by the system)

useful :____:____:____:____:____:____: useless

relevant :____:____:____:____:____:____: irrelevant

9. Accuracy of output information

inaccurate :____:____:____:____:____:____: accurate

low :____:____:____:____:____:____: high

10. Precision of output information (the variability of the output information from that which it purports to measure)

low :____:____:____:____:____:____: high

definite :____:____:____:____:____:____: uncertain

Il. Communication with the Management Information Department staff

dissonant :___:___:___:___:___:___:___: harmonious

destructive :___:___:___:___:___:___:___: productive

12. Time required for new systems development

unreasonable :____:____:____:____:____:____: reasonable

acceptable :____:____:____:____:____:____: unacceptable

13. Completeness of the output information

sufficient :____:____:____:____:____:____: insufficient

adequate :____:____:____:____:____:____: inadequate

Thank you for your cooperation

APPENDIX B

CHCS - COMBINED 3 HOSPITAL DATA
SHORT-FORM UIS INSTRUMENT OVERALL STATISTICS

TOTAL NUMBER OF SURVEYS:	340	
RESPONSE RATE (680 SENT)	50%	
MEDIAN EDUCATION LEVEL:	1	Some College
AVERAGE AGE:	32	years
MINIMUM AGE:	18	years
MAXIMUM AGE:	61	years
NUMBER OF MALES:	213	
NUMBER OF FEMALES:	127	
PERCENT MALES:	63%	
PERCENT FEMALES:	37%	
AVERAGE MONTHS USED:	12.3	
MIN MONTHS USED:	1	
MAX MONTHS USED:	36	
NUMBER USED COMPUTER BEFORE	271	
PERCENT USED BEFORE:	80%	
NUMBER USED HLT CARE COMPTR	200	
PERCENT USED HC COMP BEFORE	59%	
PERCENT USED BEFORE AND USED HC SYSTEM BEFORE	74%	
NO. PERSN MONTHS USE 1-5:	67	20%
NO. PERSN MONTHS USE 6-11:	98	29%
NO. PERSN MONTHS USE 12-17:	81	24%
NO. PERSN MONTHS USE 18 >:	94	28%

	QUEST 1	QUEST 2	QUEST 3	QUEST 4	QUEST 5	QUEST 6
AVERAGE	1.27	-0.41	0.15	0.72	0.68	1.43
STD DEV	1.29	1.62	1.73	1.68	1.57	1.30
MIN NUMBR	-3	-3	-3	-3	-3	-3
MAX NUMBR	3	3	3	3	3	3

	QUEST 7	QUEST 8	QUEST 9	QUEST 10	QUEST 11	QUEST 12
AVERAGE	1.00	0.93	1.16	0.75	1.14	-0.23
STD DEV	1.42	1.41	1.38	1.32	1.36	1.67
MIN NUMBR	-3	-3	-3	-3	-3	-3
MAX NUMBR	3	3	3	3	3	3

	QUEST 13	OVERALL
AVERAGE	0.69	9.26
STD DEV	1.53	12.77
MIN NUMBR	-3	-28
MAX NUMBR	3	39

	MID STAFF/SERV FACTOR A (1,6,11)	CONTRACTOR STAFF/SERV FACTOR B (2,12)	INFORMATION PRODUCT FACTOR C (7,8,9,10,13)	KNOWLEDGE & INVOLVEMENT FACTOR D (3,4,5)
AVERAGE	1.28	-0.32	0.91	0.51
STD DEV	1.19	1.43	1.15	1.35
MIN NUMBR	-3	-3	-3	-3
MAX NUMBR	3	3	3	3

NAVAL HOSPITAL CHARLESTON, SC
CHCS, SHORT-FORM UIS INSTRUMENT STATISTICS

TOTAL NUMBER OF SURVEYS:	101	
RESPONSE RATE (180 SENT):	56%	
MEDIAN EDUCATION LEVEL:	Some college	
AVERAGE AGE:	32 years	
MINIMUM AGE:	19 years	
MAXIMUM AGE:	56 years	
NUMBER OF MALES: (Percent)	57 (56%)	
NUMBER OF FEMALES:	44 (44%)	
AVERAGE MONTHS USED:	8.6	
MIN MONTHS USED:	1	
MAX MONTHS USED:	19	
NUMBER USED COMPUTER BEFORE	83	
PERCENT USED BEFORE:	82%	
NUMBER USED HLT CARE COMPTR	59	
PERCENT USED HC COMP BEFORE	58%	
PERCENT USED COMP BEFORE AND USED HC SYSTEM BEFORE:	71%	
NO. PERSN MONTHS USE 1-5:	28	28%
NO. PERSN MONTHS USE 6-11:	36	36%
NO. PERSN MONTHS USE 12 >:	37	36%

	QUEST 1	QUEST 2	QUEST 3	QUEST 4	QUEST 5	QUEST 6
AVERAGE	1.68	-0.50	0.57	0.97	1.07	1.99
STD DEV	1.22	1.67	1.72	1.60	1.57	1.00
MIN NUMBR	-2	-3	-3	-3	-3	-1.5
MAX NUMBR	3	3	3	3	3	3

	QUEST 7	QUEST 8	QUEST 9	QUEST 10	QUEST 11	QUEST 12
AVERAGE	0.79	0.96	1.17	0.54	1.65	-0.22
STD DEV	1.47	1.39	1.50	1.43	1.14	1.64
MIN NUMBR	-3	-3	-3	-3	-0.5	-3
MAX NUMBR	3	3	3	3	3	3

	QUEST 13	OVERALL
AVERAGE	0.59	11.26
STD DEV	1.44	11.80
MIN NUMBR	-3	-13.5
MAX NUMBR	3	39

	MID STAFF/SERV FACTOR A (1,6,11)	CONTRACTOR STAFF/SERV FACTOR B (2,12)	INFORMATION PRODUCT FACTOR C (7,8,9,10,13)	KNOWLEDGE & INVOLVEMENT FACTOR D (3,4,5)
AVERAGE	1.77	-0.36	0.81	0.87
STD DEV	0.99	1.34	1.17	1.25
MIN NUMBR	-1	-3	-3	-2
MAX NUMBR	3	3	3	3

NAVAL HOSPITAL CAMP LEJEUNE, NC
CHCS, SHORT-FORM UIS INSTRUMENT STATISTICS

TOTAL NUMBER OF SURVEYS:	121	
RESPONSE RATE (250 SENT):	48%	
MEDIAN EDUCATION LEVEL:	Some college	
AVERAGE AGE:	33 years	
MINIMUM AGE:	18 years	
MAXIMUM AGE:	61 years	
NUMBER OF MALES: (Percent)	73 (60%)	
NUMBER OF FEMALES: (Percent)	48 (40%)	
AVERAGE MONTHS USED:	12.5	
MIN MONTHS USED:	1	
MAX MONTHS USED:	36	
NUMBER USED COMPUTER BEFORE	92	
PERCENT USED BEFORE:	76%	
NUMBER USED HLT CARE COMPTR	63	
PERCENT USED HC COMP BEFORE	52%	
PERCENT USED BEFORE AND USED HC SYSTEM BEFORE	68%	
NO. PERSN MONTHS USE 1-5:	21	17%
NO. PERSN MONTHS USE 6-11:	44	37%
NO. PERSN MONTHS USE 12-17:	27	27%
NO. PERSN MONTHS USE 18 >:	29	29%

	QUEST 1	QUEST 2	QUEST 3	QUEST 4	QUEST 5	QUEST 6
AVERAGE	1.44	0.19	0.44	0.67	0.84	1.63
STD DEV	1.27	1.41	1.68	1.82	1.48	1.30
MIN NUMBR	-2	-3	-3	-3	-3	-1.5
MAX NUMBR	3	3	3	3	3	3

	QUEST 7	QUEST 8	QUEST 9	QUEST 10	QUEST 11	QUEST 12
AVERAGE	1.28	1.16	1.38	0.86	1.31	0.14
STD DEV	1.29	1.35	1.26	1.29	1.39	1.57
MIN NUMBR	-3	-3	-3	-3	-3	-3
MAX NUMBR	3	3	3	3	3	3

	QUEST 13	OVERALL
AVERAGE	0.94	12.28
STD DEV	1.46	12.41
MIN NUMBR	-3	-25
MAX NUMBR	3	39

	MID STAFF/SERV FACTOR A (1,6,11)	CONTRACTOR STAFF/SERV FACTOR B (2,12)	INFORMATION PRODUCT FACTOR C (7,8,9,10,13)	KNOWLEDGE & INVOLVEMENT FACTOR D (3,4,5)
AVERAGE	1.46	0.17	1.12	0.65
STD DEV	1.17	1.32	1.07	1.38
MIN NUMBR	-1	-3	-3	-3
MAX NUMBR	3	3	3	3

NAVAL HOSPITAL JACKSONVILLE, FL
CHCS, SHORT-FORM UIS INSTRUMENT STATISTICS

TOTAL NUMBER OF SURVEYS:	118	
RESPONSE RATE (250 SENT):	47%	
MEDIAN EDUCATION LEVEL:	BACHELOR DEGREE	
AVERAGE AGE:	32 YEARS	
MINIMUM AGE:	19 YEARS	
MAXIMUM AGE:	56 YEARS	
NUMBER OF MALES: (Percent)	83 (70%)	
NUMBER OF FEMALES: (Percent)	35 (30%)	
AVERAGE MONTHS USED:	15.3	
MIN MONTHS USED:	1	
MAX MONTHS USED:	32	
NUMBER USED COMPUTER BEFORE	102	
PERCENT USED BEFORE:	86%	
NUMBER USED HLT CARE COMPTR	78	
PERCENT USED HC COMP BEFORE	66%	
PERCENT USED BEFORE AND USED HC SYSTEM BEFORE	76%	
NO. PERSN MONTHS USE 1-5:	18	15%
NO. PERSN MONTHS USE 6-11:	18	15%
NO. PERSN MONTHS USE 12-17:	22	19%
NO. PERSN MONTHS USE 18 >:	60	51%

	QUEST 1	QUEST 2	QUEST 3	QUEST 4	QUEST 5	QUEST 6
AVERAGE	0.74	-0.94	-0.53	0.56	0.17	0.74
STD DEV	1.22	1.57	1.60	1.58	1.55	1.23
MIN NUMBR	-3	-3	-3	-3	-3	-3
MAX NUMBR	3	3	3	3	3	3

	QUEST 7	QUEST 8	QUEST 9	QUEST 10	QUEST 11	QUEST 12
AVERAGE	0.89	0.67	0.94	0.81	0.52	-0.63
STD DEV	1.47	1.47	1.36	1.22	1.25	1.72
MIN NUMBR	-3	-3	-3	-3	-3	-3
MAX NUMBR	3	3	3	3	3	3

	QUEST 13	OVERALL
AVERAGE	0.52	4.46
STD DEV	1.66	12.63
MIN NUMBR	-3	-28
MAX NUMBR	3	36

	MID STAFF/SERV FACTOR A (1,6,11)	CONTRACTOR STAFF/SERV FACTOR B (2,12)	INFORMATION PRODUCT FACTOR C (7,8,9,10,13)	KNOWLEDGE & INVOLVEMENT FACTOR D (3,4,5)
AVERAGE	0.67	-0.79	0.77	0.07
STD DEV	1.13	1.47	1.19	1.30
MIN NUMBR	-3	-3	-3	-3
MAX NUMBR	3	3	3	3

APPENDIX C

Part A: Proximity Matrix for NH Charleston

* P R O X I M I T I E S *

Data Information

101 unweighted cases accepted.
0 cases rejected because of missing value.

Absolute Euclidean measure used.

- -

Absolute Euclidean Dissimilarity Coefficient Matrix

Variable	RELMID	CHGSYS	TRNG	UNDERSTD	PARTIC	MIDATT	RELVINFO	RELVINFO
CHGSYS	30.7001							
TRNG	22.6936	22.2036						
UNDERSTD	18.9605	26.0480	16.5076					
PARTIC	19.5405	25.7245	21.1129	18.7949				
MIDATT	10.3803	32.7376	22.9074	20.7063	18.5338			
RELVINFO	19.5768	22.1529	19.9311	21.5000	16.7033	19.9875		
RELVINFO	16.9189	24.2635	19.9311	19.8935	16.8226	17.0000	13.0576	
ACCINFO	18.3439	26.2393	21.3424	20.2731	17.2679	18.5270	13:0953	15.2725
PRECINFO	20.6337	21.0772	17.4427	18.5943	18.1521	21.5174	13.4164	16.2942
MIDCOMM	9.0830	29.5466	20.1990	17.9722	17.9513	8.9503	19.2678	15.9295
TIMEDEV	27.0462	20.0749	22.9456	25.2587	23.3720	28.3328	21.9943	20.5487
COMPLETE	19.6723	21.4126	18.5338	21.0594	18.1728	21.3951	12.7769	11.6297

Variable	ACCINFO	PRECINFO	MIDCOMM	TIMEDEV
PRECINFO	14.0268			
MIDCOMM	17.3781	19.5384		
TIMEDEV	24.0728	21.8232	25.4067	
COMPLETE	16.2634	15.7083	19.3649	18.5338

- -

Time stamp on saved file: 16-DEC-93 12:09:39
File contains 15 variables, 120 bytes per case before compression

Part B: Proximity Matrix for NH Camp Lejeune

* P R O X I M I T I E S *

Data Information

121 unweighted cases accepted.
0 cases rejected because of missing value.

Absolute Euclidean measure used.

- -

Absolute Euclidean Dissimilarity Coefficient Matrix

Variable	PELMID	CHGSYS	TRNG	UNDERSTD	PARTIC	MIDATT	RELVINFO	RELVINFO
CHGSYS	22.6219							
TRNG	22.5333	20.5549						
UNDERSTD	22.9565	23.3720	21.1009					
PARTIC	17.1828	19.2224	18.0139	16.0078				
MIDATT	12.1758	25.0699	24.3516	24.4694	19.9875			
RELVINFO	15.8666	21.2720	21.2485	23.5319	17.4069	15.5786		
RELVINFO	15.4191	20.9404	21.8403	21.4767	15.6844	16.7182	13.8744	
ACCINFO	15.5000	23.1301	22.9565	23.5000	18.0831	15.4919	11.5542	13.8022
PRECINFO	18.1315	20.7244	21.9317	22.7980	18.0555	18.5472	13.3978	16.1710
MIDCOMM	12.5599	23.8327	22.6164	23.6167	19.3520	12.3693	14.0468	17.6210
TIMEDEV	24.0000	16.0701	20.5609	20.4328	18.4965	24.9750	21.2191	21.1719
COMPLETE	16.9484	20.0997	20.6882	22.4444	17.8185	17.1610	14.6116	14.8661

Variable	ACCINFO	PRECINFO	MIDCOMM	TIMEDEV
PRECINFO	14.4568			
MIDCOMM	15.5081	17.3493		
TIMEDEV	23.2863	20.3777	23.4147	
COMPLETE	15.2151	14.9666	16.5831	18.4052

- -

Time stamp on saved file: 16-DEC-93 12:09:14
File contains 15 variables. 120 bytes per case before compression

Part C: Proximity Matrix for NH Jacksonville

* P R O X I M I T I E S *

Data Information

118 unweighted cases accepted.
0 cases rejected because of missing value.

Absolute Euclidean measure used.

- -

Absolute Euclidean Dissimilarity Coefficient Matrix

Variable	RELMID	CHGSYS	TRNG	UNDERSTD	PARTIC	MIDATT	RELYINFO	RELVINFO
CHGSYS	29.4364							
TRNG	25.5832	18.8414						
UNDERSTD	18.9209	28.3019	21.7141					
PARTIC	18.9143	23.9426	18.3235	17.1391				
MIDATT	14.2653	26.5989	22.9565	18.0693	18.6212			
RELYINFO	15.3460	28.8531	25.1696	20.6882	19.4229	16.7481		
RELVINFO	15.9452	27.4089	24.4796	20.1184	19.2743	16.9041	14.6031	
ACCINFO	14.9499	29.7605	26.5801	21.3073	20.5730	16.3248	13.1909	13.7386
PRECINFO	13.5554	28.6313	23.5000	19.0853	18.3948	15.5965	12.6590	13.0000
MIDCOMM	14.1774	24.8294	21.1069	17.7482	17.5570	11.0905	16.4772	17.5570
TIMEDEV	26.3534	17.5499	19.9125	26.2298	21.3366	25.9904	25.9422	24.2642
COMPLETE	18.6011	26.4953	23.8642	21.2132	19.9437	19.5320	16.7182	14.8913

Variable	ACCINFO	PRECINFO	MIDCOMM	TIMEDEV
PRECINFO	13.6107			
MIDCOMM	16.8671	15.4353		
TIMEDEV	25.6710	25.9663	23.6749	
COMPLETE	15.4758	17.0073	18.4797	22.5607

- -

Time stamp on saved file: 16-DEC-93 12:08:50
File contains 15 variables, 120 bytes per case before compression

Part D: Proximity Matrix for Combined Hospital Data

 27-Dec-93 SPSS RELEASE 4.1 FOR IBM VM/CMS
21:31:20 Naval Postgraduate School AMDAHL 5990-500 VM/XA 2.1

* * * * * * * * * * * * * * * P R O X I M I T I E S * * * * * * * * * * * * * * *

Data Information

340 unweighted cases accepted.
0 cases rejected because of missing value.

Absolute Euclidean measure used.

- -

Absolute Euclidean Dissimilarity Coefficient Matrix

Variable	RELMID	CHGSYS	TRNG	UNDERSTD	PARTIC	MIDATT	RELVINFO	RELVINFO
CHGSYS	48.1741							
TRNG	40.9562	35.6441						
UNDERSTD	35.2775	45.0083	34.4855					
PARTIC	31.5713	40.0562	33.2566	30.0541				
MIDATT	21.4359	49.0688	40.5555	36.7967	33.0114			
RELVINFO	29.5042	42.1396	38.5000	38.0000	30.9718	30.2737		
RELVINFO	27.8971	42.1604	38.3862	35.5211	30.0083	29.2276	24.0052	
ACCINFO	28.2887	45.9129	41.0974	37.6464	32.3905	29.1505	21.8804	24.7487
PRECINFO	30.6309	41.1521	36.5718	35.0678	31.5198	32.4075	22.7980	26.3818
MIDCOMM	21.0060	45.3597	36.9459	34.5796	31.7017	18.8613	30.0042	29.5391
TIMEDEV	44.7437	31.1328	36.6845	41.7552	36.6504	45.8476	40.0874	38.2001
COMPLETE	31.9413	39.5538	36.6197	37.3798	32.3342	33.6712	25.6174	24.0416

Variable	ACCINFO	PRECINFO	MIDCOMM	TIMEDEV
PRECINFO	24.3105			
MIDCOMM	28.7576	30.3480		
TIMEDEV	42.1989	39.5695	41.8838	
COMPLETE	27.1201	27.5681	31.4881	34.3839

- -

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File contains 15 variables. 120 bytes per case before compression

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